THE GLASS INDUSTRY
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GLASS CONTAINER CONVENTION

Business Volume at New All-Time High • Big Problems as Competitive Containers and Foreign Glass Open War for Industry's Markets

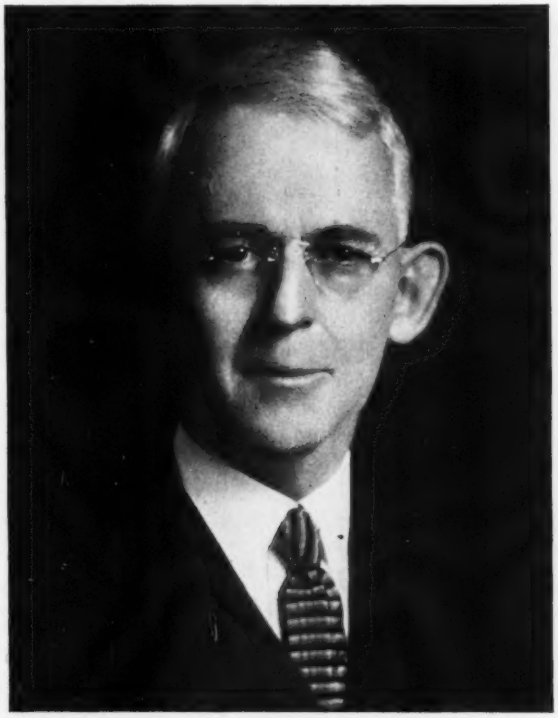
CONTINUED operation of the glass container industry at record high levels no doubt contributed in large measure to the success of the convention of the Glass Container Association held last month at White Sulphur Springs. One of the largest crowds in the Association's history was on hand. The meeting, the program, the entertainment—all were keyed to the buoyant condition of the glass container business and evoked the keenest interest.

Following the usual custom, group meetings of the Cap and Closure and the Glass divisions were held, with an open, general session on Thursday. Afternoons, when no special meetings were scheduled, were given over to golf and other forms of diversion. The annual banquet, Thursday night, was followed by a floor show and dance. Special entertainment for the ladies included a bridge tournament.

President Walter H. McClure, Hazel-Atlas Glass Co., called the general session to order. Reports from the Association officers and committee chairmen, presented by E. G. Ackerman, covered practically every important phase and activity of the industry. The following summaries will be of special interest:

Liquor Regulations: Liquor cannot be purchased today in any container except a properly marked bottle. Although these bottle marking regulations have been more or less troublesome to glass container manufacturers, they have added, and no doubt will continue to add, materially to their volume of business. It is important that not only the industry but the liquor trade and the consumer know these regulations, to which end the G.C.A., collaborating with the Treasury Department, has in preparation a manual that will detail completely the Treasury and the FACA regulations. This manual will be official and it will be revised from time to time to keep it up to date. Write for your copy.

Tariff: Importations of perfume bottles increased from $278,000 in 1932 to $427,000 in 1933, and in 1934 reached a total of $511,000. These importations came primarily from Czechoslovakia, France and Germany. However, importations from Japan during the last six months of 1934 were of such volume as to indicate that Japan soon will be an important factor in this market—if, indeed, she is not already. In New York City, during the month of April, there were on display Japanese copies of identical American-made ware that sold, delivered New York, at $1.50 per dozen compared with $1.47 per dozen for direct labor charge when made in this country. Incidentally, Japanese imports of this class of goods amounted to practically nothing one year ago.



Walter H. McClure, Hazel-Atlas Glass Co. has been re-elected president of the Glass Container Association.

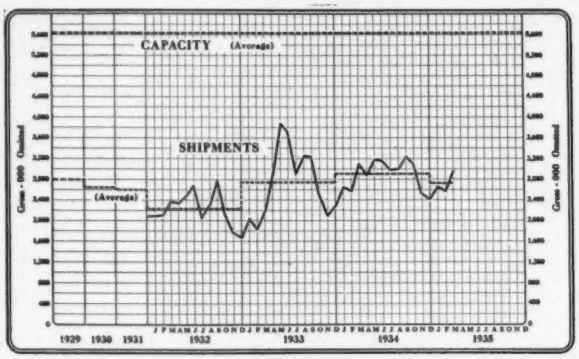
Importers are now preparing a test case on perfume bottles to determine just when is a bottle a machine-made and when a hand-made bottle. In other words, will a single machine operation constitute automatic production, or was it the intent of Congress that production should be fully automatic? In preparing their case the importers have even gone to the extreme of arranging with the government to investigate factories abroad so as to determine to just what extent the manufacturing operations are performed by machine.

As to other glass container importations, common bottles have increased materially, due to wine; min-

eral water bottles have declined some 50 per cent.* None of the reciprocal trade agreements have so far included glass containers, though the one now pending with France contains that provision. The Latchford Glass Co. has made application to the Commissioner of Customs to require all bottled wine brought into this country to have the bottles marked with the country of origin.

Silicosis: The Association is participating, along with other industries, in the study being conducted by Mellon Institute.

Oil Bottles: The market for lubricating oil** is considered one of the most promising outlets for the glass container industry. An investigation made by the American Fair Trade Practice Association (1929) showed that only 21 per cent of the oil purchased in New York City was what the purchaser asked for. Another more recent survey in other localities showed that substitution ran as high as 30 to 40 per cent. Hence the need of a tamperproof, container. Because bottled oil really is tamperproof, the oil companies are turning to bottles in constantly increasing numbers.



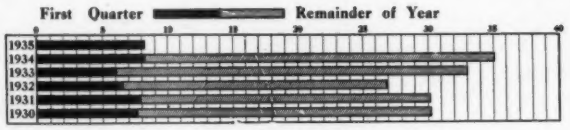


Fig. 1 (below). Glass Container Shipments by years. Fig. 2 (top). The same data, by months, compared with the total productive capacity of the industry.

Beer: Here again the competition of tin threatens one of the larger outlets for glass containers. A beer can, made first by American and later by Continental, has been put over in a big way by Krueger in Richmond, Va. This summer the can companies will make an even more extensive drive with canned beer all through the South. Canned beer has some advantages and many disadvantages, but without going into all the details, covered by the Association's report, the Glass Container Association believes that "it presents a problem which should be recognized." Nearly 1,200,000 gross of beer bottles were made in 1934, a not-so-good year.

Pacific Coast Activities: Most important of these was a survey of the second hand bottle market, which revealed that some packers of foods and drugs were using second hand bottles that had not been sterilized. The Board of Health in California has introduced in the state legislature a bill making it illegal to use second hand bottles that have not been properly washed and sterilized. As a result of these activities, the use of second hand bottles has declined. Incidentally, many packers have found it cheaper to buy new bottles than to purchase sterilizing equipment.

Traffic: The most recent accomplishment of this Committee has concerned commodity rates, a problem which, while dating back to December, 1931, has become increasingly acute of late due to the diversion of traffic from railroads to motor trucks. On April 17, the Committee called a meeting in Buffalo and the following day proposed to the railroads a 27½ per cent basis for immediate publication. The proposal was declined. The Committee arranged for reconsideration by the railroads the following day, at which time the carriers were persuaded to accept, subject to ratification by the Traffic Executives. This body approved the 27½ per cent basis at a meeting in New York on May 8, the day before the Association meeting at White Sulphur Springs.

The 27½ per cent basis results in a reduction in rates for distances up to 240 miles, where much of the truck competition exists; a larger reduction on shipments passing between points east and west of a line extending from Buffalo to Pittsburgh, owing to an inconsistent adjustment of such overhead rates; but in the aggregate this will not materially change other rates for distances over 240 miles, although removing various mal-adjustments in the latter rates over which there has been much complaint.

New sand rates go into effect July 1. While the Committee did not get all it felt entitled to, yet the new rates are lower than those first prescribed. And, most important of all, the Association is in a position to reopen the matter later, if it chooses to do so, in which event it has the strongest kind of a case to present.

Soda ash rates are in process of readjustment, with the railroads favorable to granting some concessions. Feldspar rates, also. And with bottles, less carload, a reduction may be looked for in the not distant future, in official territory.

A subject of interest to all glass container manufacturers who make liquor ware is the matter of more stringent railroad specifications for cartons and packing, scheduled to go into effect May 25. Because the notice given was insufficient for the industry to dispose of stocks on hand, the carriers have extended the effective date of the specifications six months.

Standardization: This committee has devoted most of its efforts to improving existing finishes, rather than developing new ones. Of the twenty-one new wine finishes, issued a year ago, one has been withdrawn, one new one added; new sizes have been added in two cases,

* The anti-dumping case against the Perrier Water Company of France was brought to a successful conclusion. Hence the decline.

** This market is being hotly contested by the can companies, who, incidentally, won the first round of the fight by instituting a national advertising campaign to convince the consumer that "oil sealed in tamperproof cans" was a guarantee of the genuine. The only fallacy of this sales argument lies in the fact that cans are not tamperproof. Bootleggers have been buying up empty lithographed cans. They cut away the bottoms, fill the containers with cheap oil and seal them up again so skillfully that the substitution is rarely detected. Over and above numerous dispensing advantages, bottled oil cannot be counterfeited.

and five others are being improved. A great deal of work has been done on C. T. finishes, which are among the oldest of the standards. Manufacturing efficiency in recent years has so far progressed as to indicate the possibility of reduced tolerances. This would result in improved sealing efficiency for cap users.

Work was started last Fall on a complete revision of the milk bottle and cottage cheese jar standardization, and this is progressing satisfactorily. This program involves standards covering body diameters as well as finishes. Due to competition among the dairies in demanding a tall, slender-necked bottle which will exaggerate the cream line, a serious situation has developed. Also the increasing use of cover-all caps has complicated the problem.

Paper Milk Containers: During the past six months the Association has worked actively with the milk bottle group in developing data pertaining to the paper container for milk. The threat of the paper container has become very serious. Since last summer two new type paper containers have come into the market. One was developed by the American Can Company and is being used by a dairy in Trenton, N. J., for the store trade. The other container is being manufactured in Toledo and is being used for the store trade by several dairies in different localities. The "Sealcone" paper container is being tried in several new localities.

It has been found that the large chain store interests are primarily responsible for the introduction of the paper container in new localities. Due to the fact that the paper container eliminates the deposit on bottles and the burdensome handling of returned bottles, some of the chain stores are demanding paper regardless of whether it is the proper container for handling milk. Because of this activity the threat of the paper container exists from Wisconsin to the Eastern Seaboard.

Last December the milk bottle manufacturers as a group subscribed funds to develop accurate data on the paper container. The Market Research Corporation was engaged to determine the consumer reaction to the paper container. Over 1,400 consumers were interviewed in Philadelphia, Trenton and Toledo. Valuable data for developing a program to combat this competition was obtained from this report. A series of laboratory tests were also arranged for to develop the relative merits of paper and glass as a container for milk. The results obtained so far from these tests prove the inherent advantages of the glass milk bottle.

Recently the milk bottle manufacturers have determined that a program of public relations and publicity work should be carried on to promote the use of the glass bottle. As other industries affiliated with the dairy industry, such as milk bottle cap manufacturers, washer and filler equipment manufacturers, milk bottle crate manufacturers and the alkali manufacturers, are dependent upon the use of the glass bottle, an attempt is being made to obtain their support in carrying on this program. A meeting of these affiliated companies was held at the Association office and a real interest was developed. A publicity concern presented a definite program and it is hoped that it will be possible to carry this on at least over the period of the next year.

The dairy field is not the only one in which paper is being tried. A paper container for merchandising lubricating oil through the filling stations has been developed, and is being tried by one of the oil companies in New England. It is claimed that oil can be merchandised in paper at a cost of 6 cents per gallon as compared with 16 cents and 18 cents in quart tin cans. While paper in this field would react first against the tin can, this is a great potential market for glass containers.

One of the most interesting features of the spring meeting every year is the statistical report which is presented by Victor Hall. Mr. Hall had a most heartening story to tell; namely, that 1934 established a new high record for the industry's production and shipments. Also, that the first quarter of 1935 is only fractionally below that of last year. This condition is illustrated in Fig. 1.

The broken line at the top of this chart indicates that the industry has an active productive capacity of 5,650,000 gross per month. Inactive tanks, of which there are 32, capable of producing some 12,000,000 gross per year additional, are not included. No new plants have been put in operation the past year. A few new plants are being considered. From figures Mr. Hall presented it would appear that the normal, long-time growth of the industry, commonly referred to as the secular trend, is 3.4 per cent per year as against 2.7 per cent for the country as a whole.

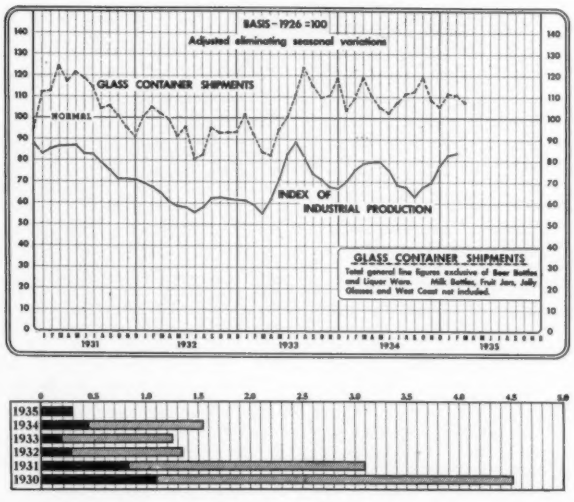


Fig. 3 (top). A comparison of glass container shipments with general industrial production (Standard Statistics Index). The excellent position of glass is emphasized by comparing this with construction contracts (below), one of the 26 indices of business used in compiling Fig. 3.

The broken line below represents the average yearly shipments. Starting with 2,800,000 gross per month in 1929, or 50 per cent to capacity, the volume declined to 2,245,000 gross per month in 1932, or 39.7 per cent to capacity.

The solid curve shows the monthly fluctuation of shipments. It is interesting to note that in 1934 the wide seasonal fluctuations did not occur as in previous years. The lack of large beer bottle volume eliminated the recurrence of the high summer peak for 1933. Also, the liquor ware volume which was heavy during the first and last

quarters, when shipments of other lines were off, has helped in smoothing this curve. Undoubtedly production schedules were benefited by a more even distribution of shipments throughout the twelve months.

Considering types of containers by classes: 1934 increases were shown by narrow neck, wide mouth, pressed ware, general purpose and liquor glasses; decreases by pressure and non-pressure, medicinal and toilet, beer and fruit jar and jelly glasses. Milk bottles remained almost constant. Liquor bottles showed the largest gain; beer bottles the biggest decrease.

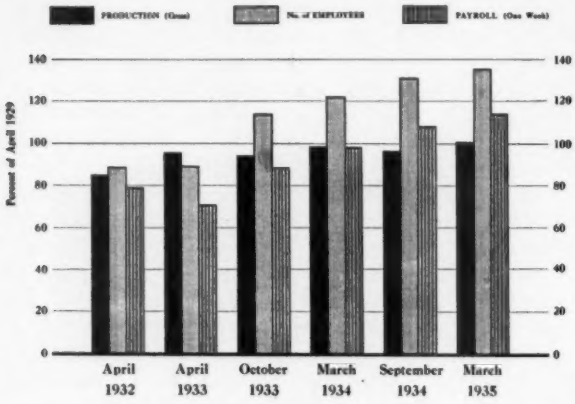


Fig. 4. Chart comparing production, number of employees and payrolls for certain months, 1932 to 1935.

In the matter of payrolls and employment, the glass container industry shows a record of fair treatment to employees equalled by few, if any, industries in the country. This is indicated by Fig. 4. Here, production, number of employees and total payrolls for the month of April, 1929, is taken as a base, and bars representing each of the factors for subsequent periods are shown as percentages of this. The following tabulation gives a more definite comparison as to the increase in employment and payrolls:

	Per Thousand Gross	Payrolls Per Gross
April 1929	5.89	62.6
April 1932	6.15	58.5
April 1933	5.48	46.8
March 1934	7.31	62.4
March 1935	8.10	72.7

Mr. Hall compared glass container prices with the prices of manufactured products as given by the Department of Labor. Except for a short period between 1921 and 1923, glass containers always have been below the general price level, as they are today.

C. R. Stevenson, Business Manager of the Association, concluded the program with his annual address. This is always interesting and forceful; in fact, Mr. Stevenson usually is a few years ahead of his audience. He predicted prosperity in the glass container business for the next two years.

Walter H. McClure, Hazel-Atlas Glass Co., was reelected a second time to the presidency of the Glass Container Association. All the old directors were returned for another term, with one exception. Roy Underwood, Knox Glass Associates, was chosen to fill this vacancy.

JERSEY CERAMISTS MEET JUNE 14

The Ceramic Association of New Jersey will hold a summer meeting at the Cumberland Hotel, Bridgeton, on June 14 and 15. By selecting a convention city that is in close proximity to important South-Jersey glass plants, the Association has made it possible to include a number of plant trips on its convention program that will prove highly interesting to glass men.

A tentative program has been arranged as follows: *Friday*: Visits to Kimble Glass Co., Vineland; Owens-Illinois Glass Co., Bridgeton; Whitall-Tatum Co. and T. C. Wheaton Co., Millville. A dinner, followed by a social program, will be held in the ballroom of the hotel that evening.

Saturday: Option of (1) Fishing excursion on Delaware Bay; (2) Golf tournament at the Cohanszik Golf Club; (3) Bridge Tournament; (4) Visits to other glass and sand plants, concerning which details will be announced at the convention.

Those planning to attend the meeting should communicate at once with the Association Secretary, G. H. Brown, Rutgers University, P. O. Box 444, New Brunswick, N. J.

The Ball family, owners of Ball Bros. Company, Muncie, Indiana, have donated a new annex to the Ball Hospital at Muncie, which will cost $200,000. This is only one of several gifts made in recent years. Frank C. Ball, president of Ball Bros. is also president of the hospital.

M. I. T. EXHIBITS HISTORICAL GLASS

There is now being exhibited at the Massachusetts Institute of Technology a special collection of glass of great interest both to ceramists and collectors. It comprises authenticated specimens of the principal types of glass made at the New England Glass Company of Cambridge, Mass., which was running between 1818 and 1885. This glass company was one of the largest and most progressive in the country during the middle of the 19th century, and its product is much sought after by collectors. Some of the specimens belong to the Institute but others were loaned for the occasion by private collectors; the finest specimens being supplied by Lura Watkins, an authority on this type of glass. The New England Glass Company originated many of the processes used today, and some authorities give it credit for making the first pressed glass, upon which is based our modern machine-made product.

This is the first of a series of monthly exhibits planned to show the development of ceramics both in this country and abroad.

As the first step in a program of expansion, the Newark Bottle Co., Inc., Newark, N. J., was reorganized on May 1. Max Berk, president of the company, was reelected to the same position. S. de Kika is the new vice president, and Abraham de Kika, secretary and treasurer. The Newark Bottle Co. is believed to be the only bottle company in that city. Mr. Berk has been identified with the bottle business since 1910.

CALCULATING FUEL REQUIREMENTS OF A CONTINUOUS GLASS TANK

By J. W. ROMIG

IN PLANNING additional capacity, it is sometimes necessary to make predictions as to the fuel requirement of a furnace, kiln or glass tank. There are various means of making such computations. Sometimes they can be made by comparison with existing installations, on either a direct or a ratio basis; but often differences are too great to permit this procedure. A second method, involving the surface temperatures of refractories, has come into considerable prominence for computing heat losses from surfaces losing heat by radiation or convection. Still a third method involves the conductivity of materials, and this is sometimes chosen because of its simplicity and because fewer assumptions are required during the investigation. A fourth combines the other methods. All methods are subject to error; but they provide a basis for estimation. The following paper presents an example of a method in which heat losses are computed by use of the material conductivities. The method can be followed through the example given.

Consider a glass tank capable of melting 75 tons of soda-lime glass per twenty-four hours. With a melting rate of 10 square feet per ton per 24 hours, a total melting area of 750 square feet is required. Some assumptions as to glass depth, melter and refiner length and width dimensions must be made. Herein a tank with a melting area of 750 square feet or 25 feet by 30 feet will be selected, a depth of 42 inches and a refiner 25 feet by 6 feet and a depth of 42 inches are assumed as proper to satisfy requirements. The next step is to compute the exposed areas, assuming a cap height and side wall height.

Approximate areas in a tank of this size together with materials involved are shown:—

Area Bottom: 1,100 sq. ft.
12″ flux block.
Area Flux Block Melting Chamber: 450 sq. ft.
12″ flux block, including bridgewall.
Area Flux Block Refining Chamber: 250 sq. ft.
12″ flux block, including bridgewall.
Area Melter End Wall above Glass: 150 sq. ft.
12″ silica.
Area Refiner End and Side Wall above Glass: 200 sq. ft.
12″ silica.
Area Sides above Glass without Port Allowances and Bridgewall: 250 sq. ft.
12″ silica.
Area Crown: Melter, 950 sq. ft. Refiner, 250 sq. ft.
12″ silica.
Area Port Necks: 1,200 sq. ft.
9″ silica.
Area Regenerators: 4,000 sq. ft.
13½″ refractory brick.

Assumed temperature, fuel and other information is as follows:

Average melting and refiner temperature	2600° and 2500°F. Respectively
Air in checkers	60°
Air out checkers	average 1800°
Producer gas in checkers	1000°
Producer gas out of checkers	average 1800°
Temperature waste gas	1000°

Also entering into fuel requirements are radiation and convection, useful heat, stingout and waste gas loss.

Assume that 800 B.T.U. is required to heat the batch and to melt 1 pound of the glass. Taking producer gas as the fuel, the following information is required:—

Coal Analysis By Weight

Moisture	3%
Total Carbon	80%
Hydrogen	6%
Oxygen	5%
Sulphur	1%
Ash	6%
Nitrogen	2%
Combustible in Ash	10%
Excess Air	50%

Steam blown into producer—.4 lb. per pound of coal.

Probable Producer Gas Analysis By Volume

CO_2	5. %
CO	26. %
H_2	12. %
CH_4	3.5%
N_2	53.5%

By following the methods outlined by the writer in THE GLASS INDUSTRY in five installments beginning December, 1929, the effective value of a fuel can be determined. The effective value in the case of a regenerative tank, when considered as a heat consuming unit, is the difference between the heat entering and the heat in waste gases computed on the basis of a unit of fuel. In this case the heat entering per pound of coal is found to be 12,100 B.T.U. and the heat in the waste gases is 3,700 B.T.U. per pound of coal. Therefore 8,470 B.T.U. are available for losses and useful heat from each pound of coal. Fuel oil or natural gas computations may be similarly developed on the basis of a gallon of fuel oil or a thousand cubic feet of natural gas. The fuel required is found by dividing the total heat loss and the useful heat of the tank by the net heat per unit of fuel, i. e., 8,470 B.T.U. per pound of coal in the example.

The actual heat required for melting the batch is considered as the useful heat requirement. If one pound of the glass in question requires 800 B.T.U. a ton requires 1,600,000 B.T.U. for melting. The capacity taken for the example is 75 tons per 24 hours, so a total of 120,000,000 B.T.U. are required for melting per 24 hours.

During the melting period tank refractories in the crown sides, endwalls, bottom and port necks are heated to a high temperature on the inside and exposed to relatively low temperatures on the outside. The magnitude of the heat losses is found by heat transfer calculations involving the coefficients of heat transmission for the refractories. The general formula for the heat loss is given on the next page.

$$L = \text{Loss} = \frac{T_1 - T_2}{\frac{D}{K} + \frac{D_1}{K_1} + \frac{D_2}{K_2} + R}$$

where L equals Heat loss in B.T.U. per sq. ft. per hour.

T_1 equals Inside temperature in degrees F.

D, D_1, D_2, are thicknesses, and K, K_1, K_2 are coefficients for the rate of heat transfer of the materials in the wall layers.

R equals the coefficient for surface resistance for the outside taken as 0.2 for usual tank conditions.

MATERIAL	VALUE OF K Average Inside-Outside Temp.
Silica	7 at 400°F.
Silica	10.5 at 1500°F.
Silica	9.3 at 1200°F.
Fire brick ..... 7.2 for 700°F. Av.	7.8 at 1000°F.
Flux block ..... as for fire brick	9.0 at 1500°F.

In selecting average values of "K," there is a chance for error because an estimation of outside refractory temperature must be made.

TABLE NO. 1

The heat loss is computed using values of "K" as previously shown.

Tank Part	Area Sq. Ft.	Material	Thickness, inches	Temp. °F. Inside	K Average	B.T.U. Loss per hr. 10% added for Vertical surface	Probable Outside Refractory Temp. °F.
Bottom	1100	Flux	*8	2600	9.0	2300	400
Melter sides below glass	450	Flux	*8	2600	9.0	2530	400
Refiner sides below glass	250	Flux	12	2500	9.0	1710	400
Melter ends above glass	150	Silica	12	2600	10.5	2020	400
Refiner ends and sides	200	Silica	12	2500	10.5	1980	400
Melter sides above glass	200	Silica	12	2600	10.5	2020	400
Melter crown	950	Silica	12	2600	10.5	1840	400
Refiner crown	250	Silica	12	2500	10.5	1800	400
Port necks out	600	Silica	9	2600	10.5	2350	400
Port necks in	600	Silica	9	2000	9.3	1775	400
Regenerator wall-cold	2000	Fire brick	13½	1200	7.2	580	200
Regenerator wall-hot	2000	Fire brick	13½	1700	7.8	900	300

* Melter sides and bottom are normally 12" but an average of 8" is nearer normal thickness throughout a campaign.

Stingout loss is of considerable magnitude with high temperature combustion if a plus pressure exists in the combustion chamber, providing that mantle block, peep or other openings exist. If a negative pressure exists in the combustion chamber, infiltration losses result.

For the glass tank fuel requirements, assume:—

Average waste gas .08 lb. per cu. ft. at 60°F.

Average waste gas .013 lb. per cu. ft. at 2600° F.

On this basis there are 77 cu. ft. per lb. at 2600°F.

Pressure in furnace is assumed as .05" water gauge average or .26 lb. per sq. ft.

Area of openings—assume a total of 1 square foot.

Discharge of opening orifice .75.

Velocity = $.75\sqrt{2g\,(P_1\text{-}P_2) \times U} = .75\sqrt{64.4 \times 26 \times 77}$ = 36 ft./sec.

Vol. gases discharged = 1 x 36 x 3600 = 130,000 cu. ft. per hr.

Assume average B.T.U. per cu. ft. of gas is 60 at 2600°F.

B.T.U. loss = $\frac{60 \times 130{,}000 \times 520}{3060}$ = 1,330,000 B.T.U. per hour.

TABLE NO. 2

SUMMARY OF LOSSES

Item	B. T. U. Loss Per Hour
Stingout	1,330,000
Bottom	2,530,000
Melter sides below glass	1,140,000
Refiner sides below glass	430,000
Melter end above glass	300,000
Refiner end and sides above glass	390,000
Melter sides above glass	400,000
Melter crown	450,000
Refiner crown	450,000
Port necks	2,470,000
Rengerator walls inside	1,160,000
Rengerator walls outside	1,800,000
Total above glass	12,850,000
Heat for melting	5,000,000
Total above	17,850,000
Stack loss, 2100 x 3700	7,830,000
Total heat requirements	25,680,000

The fuel requirement is found by dividing the total loss (excluding stack loss)—17,850,000 by 8,470 (the net available heat) and is 2,100 pounds per hour. Such a tank would require a little over 25 tons of coal per 24 hours.

As refractories diminish in thickness and checker conditions impair regenerative recovery the above consumption would be increased. The amount of increase is problematical but an allowance of 15 per cent is considered ample to cover such conditions.

N. Y. CHEMICAL SHOW DEC. 2

The Fifteenth Exposition of the Chemical Industries—popularly known as the Chemical Show—will be held during the week of December 2 at the Grand Central Palace, New York City.

"DIFFUSIONAL PROCESSES"

Chemical engineering problems connected with heat transfer and with the transfer of material from one phase to another were discussed by Professor Walter G. Whitman of the Massachusetts Institute of Technology at the Chemists' Club, New York City, on May 11th. Prof. Whitman's paper was entitled "Diffusional Processes." The transfer of material and of heat from one phase to another is largely a problem of diffusion through films at the fluid boundaries. Recent work has demonstrated, however, that mixing by turbulence within the main body of fluid is seldom so complete that non-uniformities can be disregarded. He cited numerous examples of transfer problems which are dominant in the practical operations of chemical industry. He showed that apparently diverse phenomena could be correlated by simple generalizations and emphasized the value of such correlations in the work of the chemist and chemical engineer.

GLASS MAKING IN MEXICO

Vidrien Monterrey Factory Rivals the Finest

By J. B. NEALEY
American Gas Association

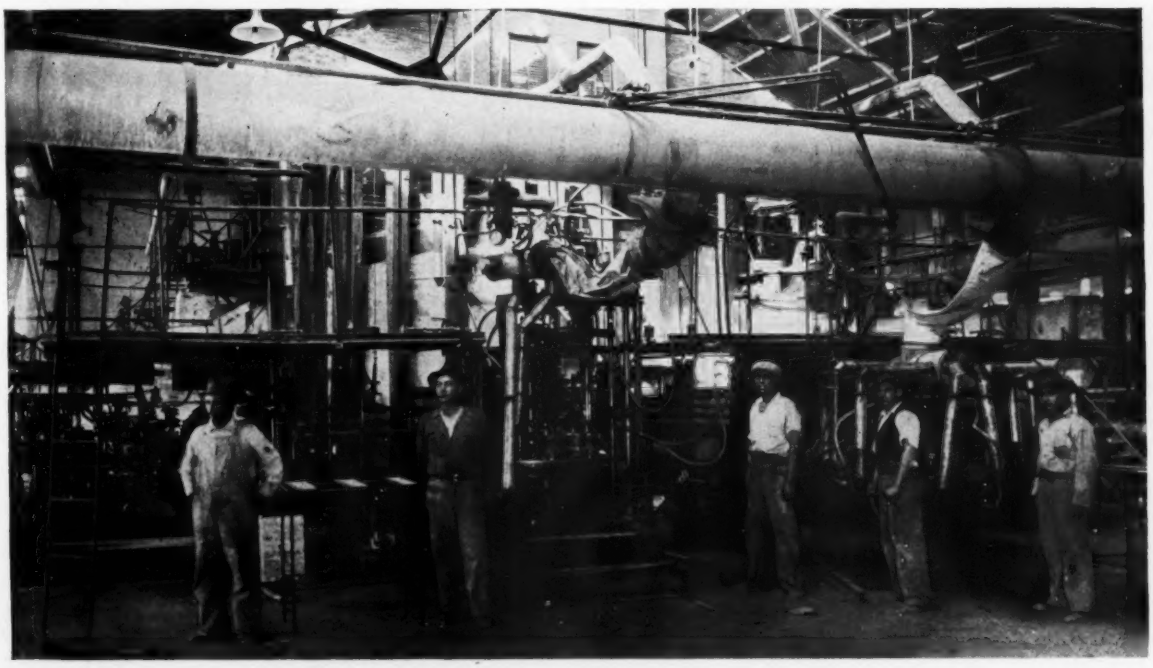
THE process of glass making is the same the world over; that is, fundamentally. But vast differences in quality, color effects, beauty, etc., exist, which are due directly to workmanship and technique both in the handling and shaping of the ware as well as in the formulas developed.

These points are admirably demonstrated by the beautiful products made by the Vidrien Monterrey, S. A., whose plant, the largest in Mexico, is located in Monterrey. Here is made every conceivable glass item from bottles and tableware to laboratory vessels and plate glass in every possible color. Self contained from raw material to finished products this concern maintains a foundry with two cupolas and a machine shop for the manufacture of most of the machinery it uses; a division devoted to the making of the clay pots, in which much of the glass is melted, together with many large and special shapes, and a woodworking mill which produces the boxes and crates in which the finished ware is shipped.

There are 12 glass melting furnaces here, eight continuous and four day tanks, all designed and built by the company itself. Not long ago gas was piped down from Texas, U. S. A., to Monterrey and this plant has employed this refined and economical fuel, in all of its furnaces and other operations ever since. The eight continuous glass furnaces serve 14 automatic machines which turn out bottles, tumblers, and other glass items, mechanically and continuously.

The first division of the glass plant is equipped with two continuous furnaces and three day tanks. These furnaces which are of the regenerative type with air cooled walls are built of brick; the hearths are lined with cast mullite blocks and the arches are of silica brick being held together with buckstays. They are 20 and 30 ton capacity respectively, one being 30 ft. long, 20 ft. wide and 10½ ft. high while the other is 38 ft. long, 18½ ft. wide and 11 ft. high, outside dimensions. The molten glass bath in each is 42 in. in depth. One is fired with six gas burners and the other with eight. Each burner has a separate combustion chamber, outside the furnace, which sets on top of checker work. Each combustion chamber is 4 ft. long and 3 ft. wide while the checkers are 8 ft. deep.

Melting glass to continuously supply automatic glass ware machines is quite a different proposition from melting glass in batches for handwork. In the continuous process the viscosity of degree of fluidity of the molten glass must be maintained at a definite degree for there are only two control elements to regulate its intermittent flow into the machines. These are viscosity and time and if perfectly coordinated, the exact quantity necessary will drop into each mold as it is positioned under the boat. The least variation will



A Battery of Automatic Forming Machines at Work.

throw the entire process off. The vital factor is heat control at its highest efficiency. The glass is maintained at close to 2600 deg. F.

The refractory bridge wall in this furnace which separates the melting from the refined section, is located just back of the discharge end and has an 18 in. sq. throat at the bottom. Batches are made up on the furnace floor, lifted by bucket elevator into a steel hopper and from there dropped by gravity into the furnace dog house. Gas is delivered to the burners at 15 lbs. pressure and no primary air is used for combustion, only preheated secondary air.

The largest of these furnaces feeds four automatic machines through four boats, two of which extend from the discharge end of the furnace. The other two are located, one on each side just back of the end wall. This boat (as well as the plunger and timer) were developed and patented by this concern.

Annealing is accomplished in two gas fired lehrs of the full muffle type, each being 71 ft. long, 5 ft. high and 8 ft. wide. They are built of brick and refractory blocks, as are the muffles which are 44 ft. long and 12½ ft. high. Each muffle is heated with a single gas burner of the blast type and the waste products of combustion are removed through a stack. An endless herringbone steel wire belt carries the ware through the lehr and extends 14 ft. beyond for cooling and ease in removing. The temperature of the lehr is maintained at 1020 deg. F at the charging end, and is allowed to drop gradually to room temperature at the other end. Some 14 ft. from the discharge end, a portion of the hot air is drawn out through the top of the lehr, by a fan and induced draft. Between this and the discharge end are five steel plates or doors, in the top of the lehr, that can be opened, wholly or partially, to further regulate the temperature. The conveyor belt, of course, is operated by motor.

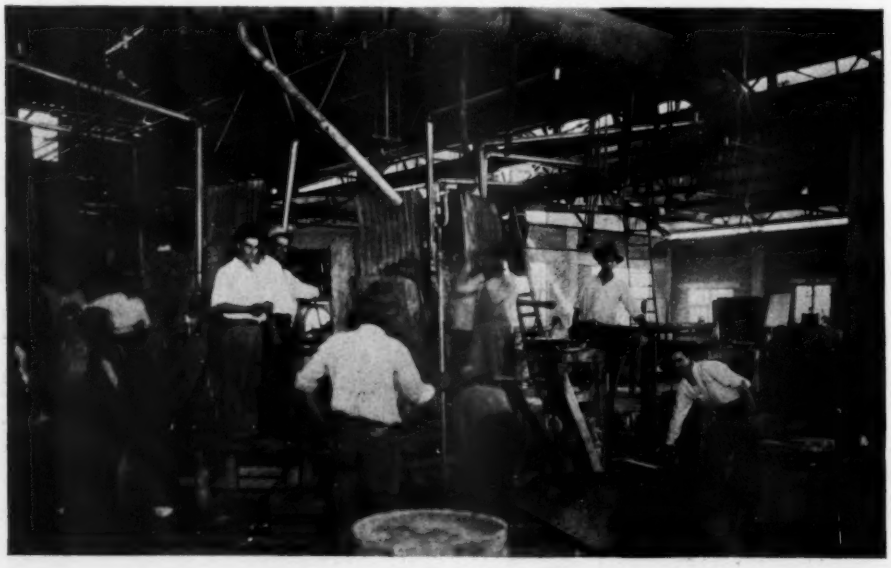
The third furnace in this division, is 8 x 12 ft. inside dimensions with a 24 in. bath depth and is used interchangeably for melting glass or making sodium silicate (water glass). Two gas burners with checkers fire into the charging end so the doghouse is located in one side, close to the end wall. There is an opening in the roof of the furnace which is used for charging when making sodium silicate, and this product is poured, every 12 hours, into a steel tank, 15 x 26 ft. and 18 in. deep. From 8 to 9 tons are poured at a time and four hours later this is broken up with bars and removed for shipment.

Tumblers, bottles, pitchers, tableware, etc. are produced in Division 3 which is served by three furnaces. Of these, two are continuous furnaces and the other a two pot furnace to serve crews making very fine tableware. The two gas fired lehrs, similar to those already described, are to remain unchanged.

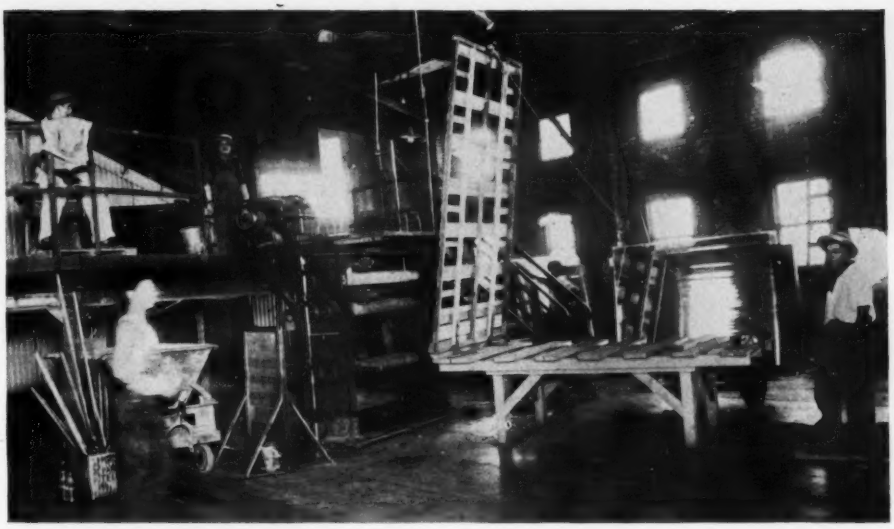
A single furnace serving two automatic bottle machines occupies Division 4. This furnace is 10 x 18½ ft. inside dimensions and has a 42 in. deep bath. The combustion chambers are 6 x 9 ft. and the checkers are 12 ft. deep. A slightly smaller furnace, but of the same type, is in Division 5, where all of the work is done by hand. This furnace has six gathering holes in the discharge end where gatherers procure glass for from 12 to 16 crews. Lamp chimneys, tableware and many other articles are made here. There is also a smaller day tank 52 in. x 102 in. fired with two gas burners set in one end. These fire directly as there are no checkers and there is no dog house, as the furnace is charged through one of the two gathering holes. There are two lehrs, one 71 ft. long and the other 85 ft. in length and these are similar to the ones already described.

All of the work in Division 7 is by hand and glass is melted in two day tanks and one continuous furnace. This is 39 ft. long, 10 ft. wide and holds a bath 42 in. in depth. As it is not provided with regenerators it will be fired with burners to which both air and gas are supplied under pressure. There are seven gathering holes in the discharge end of this furnace but it is so designed that it can be changed over to serve a drawn sheet glass machine. The day tanks are 52 in. x 102 in. with 14 in. baths. Each is fired with burners similar to those firing the continuous furnace. A motor driven blower furnishes the air for the burners in this division.

Sheet glass is made in Division 8 with a special



This factory also produces a quantity of hand made ware, which is fabricated in this department.



The upper portion of a sheet glass machine and the floor serving it. Vidrien Monterrey makes practically every type of glass, by hand and by automatic machine.

machine 27 ft. high that draws the glass straight up vertically from the bath, and between rollers that smooth it out and regulate its thickness. The furnace is 98 ft. long and 14 ft. wide with a 48 in. bath and is similar to those already described. It has a capacity for 500 tons of molten glass and serves three sheet glass machines which use on an average of 28 tons daily. At the discharge end are four wings each of which protrudes from the furnace 10 ft. and is 8 ft. wide and 3 ft. deep.

Regulation of the flow of the molten glass from the bath into the ascending sheet is aided by the use of a debiteues, or refractory block, which is submerged in the glass in the wing. This block is 74 in. long and 14 in. wide and has a slot in the center. The wire screen pulls from this slot. The machine is cased in steel plates that can be partially opened or removed and the whole forms a lehr for the annealing of the glass sheet as it progresses upward. Gas burners are used in the wing and also in the bottom of the machine for exactly regulating temperatures.

Temperature regulation is also aided by the use of ardometers, visual pyrometers and a recording pyrometer that charts the heat for six different sections of furnace. In addition to this operators are continually watching all parts of the bath with optical pyrometers. There are several day tanks in this Division from which molten glass is dipped and poured onto tables and rolled into sheets.

Showing checkers and gas burners on one side of one of the combustion furnaces.

The debiteues or refractory blocks used in the wings, are first made up in the refractory Division and then fired in a double chambered furnace, each chamber of which is 5½ ft. x 9 ft. inside. This is heated with two gas burners in each chamber, and these under-fire the work. Another furnace, 9 ft. x 11 ft. inside, and underfired with two gas burners, is employed in firing the refractory floaters used in the day tanks in the Sheet Glass Division.

Other products from the refractory Division are fired in 18 round kilns of the down draft type. Each is equipped with six gas burners which fire against bag walls, thus causing the heat to rise. A stack draft pulls the heat down through the floor of the kilns and out.

The grinding, glazing and decorating divisions are all provided with the most modern machines and devices and taken all in all the work produced in this Mexican plant is surpassed nowhere on the North American Continent.

ILLUMINATING CONVENTION SEPTEMBER 3

The Illuminating Engineers Society will hold its annual convention in Cincinnati from September 3 to 6th, with headquarters at the Netherlands Plaza Hotel. These conventions have been eminently successful in promoting the rapid development of the art and science of lighting in this country, and although this is but little more than three decades old, the amount of fundamental data accumulated and disseminated has been astounding.

ELECTROCHEMISTS HONOR F. J. STONE

Frank J. Tone, president of the Carborundum Company, Niagara Falls, N. Y., has been awarded the Edward Goodrich Acheson Medal by The Electrochemical Society. The award is made every two years "to the person who shall have made a distinguished contribution to the advancement of any of the objects, purposes, or activities of the society." It is the highest honor which The Electrochemical Society can confer.

THE CZECHOSLOVAK GLASS INDUSTRY

AFTER the establishment of the Republic in 1918 approximately 75 to 80 per cent of all the glass plants and factories of the former Austro-Hungarian Empire were found on Czechoslovak territory. The capacity of these plants were calculated for a home market of 50,000,000 people, and also for sizeable world markets as well. With the domestic market reduced to 15,000,000 people the industry became more than ever dependent on export markets which necessitated certain changes in the nature and scope of glass manufactory.

Glass-making is one of the oldest Czechoslovak industries, as the first glass works of the country date back to the eleventh century. The hollow glass factories of Bohemia were founded in the fourteenth century and by the seventeenth century had attained a leading position in world markets, where Bohemian glass had become a synonym for highest quality and workmanship.

Originally the main export was crystal glass, in the manufacture of which pure quartz and wood potash were used. In the course of time the pure quartz deposits were worked out and quartz sand deposits found in various sections of the country were then exploited. These too failed in time, nevertheless today the glass industry is one of the branches which continues to draw the bulk of its raw materials from home sources.

With wood for firing purposes becoming increasingly scarce, the industry tended to concentrate in the lignite area in northern Bohemia, although glass plants are found in practically all sections of the country. Machine production in the glass industry is of recent origin, having become significant only since the war in the sheet glass branch. The mirror glass industry also deserves special mention as it is more than a hundred years old and machine production and large scale manufacture predominate. As regards the hollow glass branch there is still a predominance of small concerns, concentrated machine output have been adopted in the making of bottles and plain water glasses.

Following several years of constant decline, last year brought a moderate but very heartening improvement in the Czechoslovak glass industry. On February 17, 1934, the gold content of the crown was reduced by one-sixth and as a result the competitive position of Czechoslovak glass in foreign markets was, at least, partially restored, with a consequental rise in exports as against 1933. As may be seen from the following table, both imports and exports declined precipitously between 1929 and 1933, with 1934 marking a reversal of the downward trend:

Notwithstanding the improvement in domestic and foreign sales, only slightly more than half of the some 120 to 125 glass works in the country were in operation throughout 1934, and of the 40 to 50,000 workmen associated with the industry approximately half were registered as unemployed at the close of the year.

Czechoslovak Foreign Trade in Glass and Glass Products

	IMPORTS			EXPORTS	
	Metric Tons	1000 Crowns		Metric Tons	1000 Crowns
1927	2,017	47,363	1927	137,708	1,143,970
1928	2,525	63,321	1928	206,311	1,268,774
1929	3,406	68,934	1929	222,800	1,378,518
1930	4,111	54,200	1930	191,800	1,153,805
1931	2,861	43,659	1931	184,396	974,110
1932	1,437	28,916	1932	118,781	611,266
1933	782	20,629	1933	110,087	531,262
1934*	714	24,844	1934*	118,258	597,005

*Preliminary.

In the absence of any accurate data on employment of the industry or on the glass output during the year, the best available gauge of production is the Maiwald index of activity for the glass industry, which is compiled on the basis of indirect indicators. According to this index, activity in the industry averaged (1929 equals 100) 83.4 for 1930, 75.1 for 1931, 54.5 for 1932, 48.6 for 1933 and 51.5 (computed on an eleven months' basis) for 1934.

From 75 to 80 per cent of the output of Czechoslovak glass factories is usually exported and exports have declined rapidly in recent years as a consequence of the depression and of the import and currency restrictions adopted by many countries, Czechoslovak glass manufacturers realize that the regaining of export markets will at best be a gradual process and that some time must elapse before the obstacles and unfavorable conditions hampering progress can be effectively eliminated. For this reason there has been a movement on foot to effect a rationalization of production and an adjustment of working capacity somewhat more nearly to present day requirements. As a result a Governmental decree was issued in April 1934 forbidding the establishment of new glass factories, the reopening of a closed factory or an increase in the capacity of existing ones without a special permit from the Ministry of Commerce. No new factories were opened up during the year but a number of important consolidations and reorganizations took place in the industry.

ANOTHER important regulation touching the glass industry and trade, especially the Gablonz branch, was issued during the year requiring firms that export or deal in imitation jewelry, bangles, buttons, paste stones, dress and hat trimmings, ornaments of glass and the like to purchase them from glassmakers and craftsmen who are trained and competent workmen and who are in possession of an official identity card as evidence of that fact. The regulation is designed to eliminate illicit workers and traders, thereby to raise the standard of the goods produced as well as the trade morale.

A consultative body attached to the Ministry of Commerce has been appointed to draw up reports on conditions of production and marketing in the individual branches of the glass industry. In this body employers and employees are represented equally.

According to preliminary data furnished by the Czechoslovak Statistical Office for 1934, Czechoslovak imports of glass and glass products totalled 714 metric tons in a value of 24,844,000 crowns* ($985,760), as against 782 tons and 20,629,000 crowns ($825,160) in 1933, a decline of 10 per cent in quantity but an increase of about 20 per cent in crowns. In 1934, as

*One crown equals $0.04195 at the present rate of exchange. For the sake of simplicity all conversions in this paper have been made at the rate of 4 cents to the crown. It should be noted, however, that prior to February 17, 1934, the gold value of the crown was 20 per cent higher than it is now and that in 1933 the value of the dollar fluctuated widely.

against the preceding year, all items of imports declined (quantity) except small glass rods, plates and tubes, optical glass and imitation gems, which made gains. Of the items listed separately in the Czechoslovak foreign trade statistics unset imitation gems accounted for about 29 per cent of the total imports; common white hollow glass for 9 per cent; sensitized photographic dry plates, raw glass, and optical glass for more than 5 per cent each; and moulded and massive glass for 4 per cent.

Glass Exports Increase

Total exports of glass and glass products in 1934 registered a marked improvement over shipments abroad during the preceding year, increasing from 110,087 metric tons valued at 531,262,000 crowns ($21,250,480) to 118,258 tons valued at 597,005,000 crowns ($23,880,200). This represented a gain of more than 8 per cent in quantity and 12 per cent in value on a crown basis.

Exports of all types of glass increased in quantity as against 1933, except small rods, plates and tubes; natural colored bottles; other natural colored hollow glass; bulbs for electric lights; cathedral glass; bevelled plate and sheet glass; beads and objects of beads, pearls, gems, etc. The most important increases were in the exports of raw glass (40 per cent); colored hollow glass (42 per cent); fine etched and cut hollow glass (30 per cent); moulded and massive glass (18 per cent); wired glass (99 per cent); optical glass (7 per cent); and imitation gems (31 per cent).

Of the total exports in 1934, plate and sheet glass accounted for more than 19 per cent; fine etched and cut hollow glass for 17 per cent; buttons, corals, bangles, etc., for 13 per cent; moulded and massive glass for 10 per cent; objects of glass beads, pearls and gems for 8 per cent; hollow glass with smooth bottoms, edges, etc., for 6 per cent; glass beads for 5 per cent, and imitation gems for 4 per cent.

Comparative figures for Czechoslovak exports of glass and glass products during 1933 and 1934 are summarized in the table at the bottom of this page.

Foreign Trade by Countries: In 1934, the same as in previous years, Germany and Austria ranked first and second, respectively, as suppliers of glass and glass products to Czechoslovakia. France came next followed by Great Britain and the United States. Imports from the latter country totalled 393,000 crowns ($15,720) in 1934, a decline of about 24 per cent and 63 per cent, respectively, as against 1933 and 1932. During 1934, imports from Germany, Austria, Italy and the Netherlands, though small, registered gains as compared to the preceding years.

Czechoslovak exports of glass went to practically all countries of the world in 1934, but Great Britain, the United States and Germany ranked first, second and third, respectively, as purchasers, followed by France, Italy, Austria, British India, the Netherlands and Switzerland in the order named.

Exports to the United States, which fell from 86,760,000 crowns ($3,470,400) in 1932 to 70,755,000 crowns ($2,830,200) in 1933, rose to 72,302,000 crowns ($2,892,080) in 1934, a gain of about 2 per cent.

Thomas Walker Page, of Virginia, has been reappointed vice chairman of the Tariff Commission, and on June 17 will enter a new term of office for six years. Mr. Page is chairman of the Committee for Reciprocity Information, which is a part of the organization for carrying out reciprocal trade agreements with foreign countries.

Czechoslovak Exports of Glass and Glass Products

	EXPORTS			
	1933		1934	
	Metric Tons	1000 Crowns	Metric Tons	1000 Crowns
Total	108,477	531,262	118,258	597,005
Including:				
Raw glass	401	2,421	561	3,335
Small rods, plates and tubes	26	186	5	29
Bottles of natural color	16,334	17,499	12,094	17,799
Other hollow glass, natural color	143	287	78	225
Hollow glass, common, white	4,990	20,421	5,260	21,462
Hollow glass, common, colored	1,482	6,925	2,106	8,969
Hollow glass, smooth, bottoms, edges and stoppers emery ground	6,194	30,695	7,546	37,449
Hollow glass, fine, etched, cut, etc.	6,142	80,464	7,973	101,336
Laboratory glass	*	*	2	54
Bulbs for electric lights	687	7,330	555	6,966
Moulded and massive glass	9,849	43,684	11,623	61,256
Plate and sheet glass	54,074	93,023	61,876	116,432
Bevelled plate and sheet glass	145	716	104	586
Cathedral glass	346	508	284	411
Foliated glass	382	5,238	394	3,369
Framed mirrors	1	17	2	14
Wired glass	400	755	795	1,278
Photographic dry plates	25	432	29	571
Optical glass	437	7,090	469	7,297
Watch crystals	7	616	9	760
"Gablonz" products:				
Beads	1,306	31,831	1,289	30,300
Imitation pearls	....	48	....	125
Pendants for chandeliers	188	5,080	218	5,683
Buttons, corals, bangles, etc.	2,683	66,984	2,906	78,188
Imitation gems (unset)	125	23,250	165	26,612
Objects of beads, pearls, gems, etc.	1,507	73,742	1,019	49,550
Other glass products	573	11,797	896	16,799

*Included in other items.

ALLOY ORIFICES IN REFRACTORY DIES

DEVELOPING a refractory die with an alloy lining has made it possible to obtain a uniform flow of glass when filling lamp bases and has brought to Henry K. Richardson and Frank A. Newcombe the 1934 Award for the Outstanding Accomplishment of the Westinghouse Lamp Company.

The alloy lining has increased the life of dies by 190 times and production from 7 to 15 per cent. Uniform glass flow has in turn enabled the adoption of automatic temperature control for oil burners on the glass furnaces. Mr. Richardson discussed the new alloy lined die before the annual meeting of the American Ceramic Society in Cincinnati last year.

Black insulating glass in the bases of incandescent lamps is delivered to the basing machine from a tank so small that no stack is required. A positive pressure is always present in the furnace. An oil burner, acting both as a melting and delivery burner, fires the tank from one side. The batch is changed intermittently every 20 minutes.

At a speed of 220 per minute, the brass shells of medium screw bases, such as those on general household lamps, are indexed automatically into the glass stream flowing through an orifice in the bottom of the furnace. In this fraction of a second, an exact amount of glass must fall into each base. Hence the temperature, diameter, and speed of flow of the glass stream must remain within close limits to assure uniform production.

Frequent Replacements

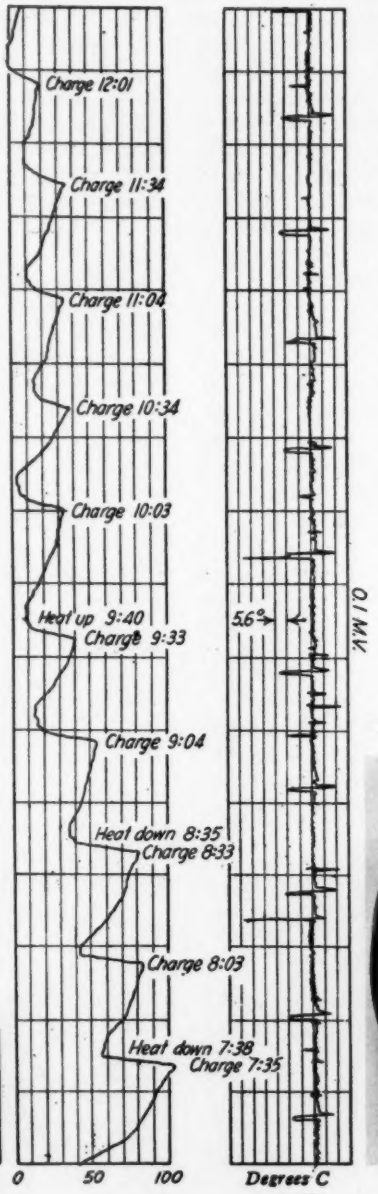
In the past, the porcelain die would erode within a few hours, making it difficult to maintain a uniform stream. Glass delivery had to be adjusted at frequent intervals by changing the temperature in the furnace or by doctoring the batch with sand or soda. Sooner or later the glass composition became unstable and fractured glass frequently occurred.

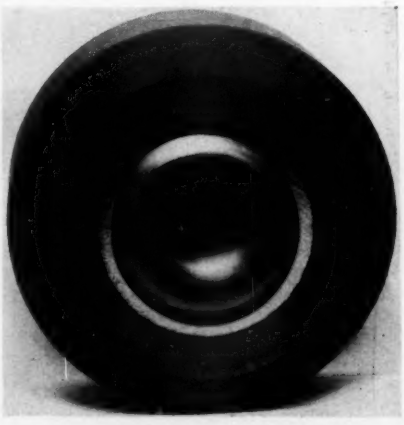
Finally the operation had to be stopped altogether to allow for a complete new start. By the time 200,000 bases were filled (15 hours at the most) a new plug or an entire new die had to be installed. The time for these adjustments slowed production, introduced considerable wastage, and in general contributed to high manufacturing costs.

With the new alloy-lined die, these difficulties have been minimized until they are now negligible factors. Uniform flow of glass and automatic temperature control make it possible to fill approximately 38,000,000 bases without a die change.

After numerous tests with high-temperature alloy metal and various refractory compositions, none of which proved better than porcelain, an alloy of 90 per cent platinum and 10 per cent rhodium was found best in resisting the abrasive action of the hot flowing glass. A lining of this alloy, 0.030 inches thick, is inserted into an Alundum refractory support to form the die now in general use in the base works of Westinghouse Company.

A die with an orifice of 0.756 inches produces a glass stream ⅛ inches in diameter. It falls about two feet to the basing machine. From a point 6 inches below the die, the stream necks down quickly to form a perfect cylinder. The acting forces have become so balanced that a constant volume is flowing past any point at a given time. As far as can be determined with the most delicate of instru-

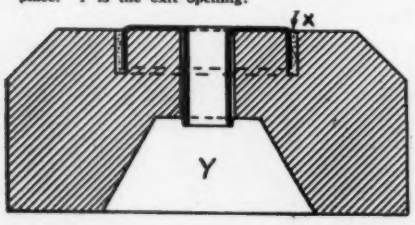


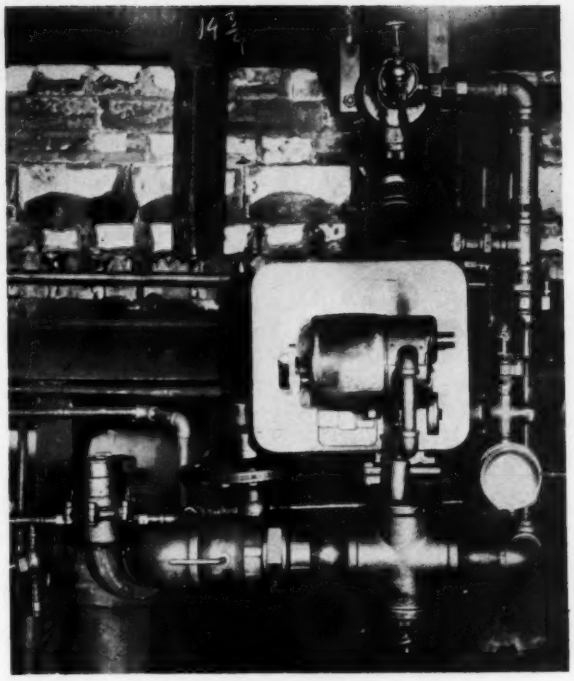


(Center) The left hand Chart showing the variation in the temperature of the glass stream when the temperature control was manually operated. That on the right shows the temperature curve after automatic control was made possible by an alloy lined die. The variation was reduced to one-tenth.

(Right) View of alloy lined die showing the inlet opening.

(Left) Cross section of refractory die with alloy lining, showing its construction. Cement is injected at X to hold the lining firmly in place. Y is the exit opening.





View of the Automatic Control Burner. The Proportioning Valve is behind the shield.

ments, the temperature of the stream is constant for this 18-inch section.

Automatic Temperature Control

From a standpoint of production efficiency and economy, the automatic temperature control is perhaps the most important outcome of uniform glass flow. Temperature control methods, which heretofore have lagged woefully behind the development of other equipment, are now placed upon an equal basis.

The desirable temperature of the glass stream is 1200 C. Porcelain dies would change so rapidly in diameter, however, that it was necessary to replace them at frequent intervals in order for the stream to deposit the exact amount of glass into each base shell and also to guard against "cold" glass. The porcelain die would wear away so fast as to cause a temperature change of 100° C. within five hours. Now, the temperature change is never more than 10° C. in an identical period.

With automatic temperature control it is now possible to meet the requirements of high efficiency operation with a minimum of unit manufacturing Cost. The temperature can be controlled within a plus or minus 5 C. on a 1/32 inch stream at 1200° C.; excess pressure effects can be handled without pulsation when the oil burner is opened up after charging; the temperature control operates from the glass stream itself; the control apparatus is reliable when subjected to heat and abuse; the burner remains set for a week's run; the burner is standard equipment and replacements are now a simple procedure.

"Glass Enters a New Age" is the title of an interesting article appearing in *The Atlantic* for June.

FLOYD UNDERWOOD DIES

Floyd Underwood of the Knox Glass Associates died in Chicago on May 3 at the Garfield Community Park Hospital. His death was the result of a very serious operation for ulcers of the stomach, complicated by an internal hernia, believed to be the result of adhesions that had developed over many years. Funeral services were held in Chicago, after which the body was removed to Knox, Penna., for interment in the Perryville Cemetery.

Mr. Underwood, who was in his thirty-eighth year, was one of the best known glass men in the Chicago area, where he had been in charge of sales for his company for the past twelve years. He is survived by his wife Josephine, a son, George, and a daughter, Patricia. He is the brother of Chester R. Underwood, in charge of Knox Glass operations at Jackson, Miss., and also of R. R. Underwood, president of the company.

MISSISSIPPI PERFECTS NEW GLASSES

Misco, a wire glass of quadrangular mesh, every intersection of which is spot welded, has been announced by the Mississippi Glass Company as the most forward development in American made glass of this kind. Misco is the result of more than five years of experimentation, during which it has been necessary to solve the most difficult technical problems incident to its manufacture. Foremost among these was the electric welding of the mesh itself, where it was necessary to devise a means of positively controlling the flow of electricity to each one of the welded intersections. Interruptions or any change in the current at any one of the welding points might affect the welding of a large area of the glass.

The use of a quadrangular meshed glass permits of substantial economies in cutting, since a change from vertical to horizontal glazing is not conspicuous. This, together with its vastly superior appearance, more than compensates for higher costs.

Another recent development of the Mississippi Glass Company is Coolite. Although details of this glass were announced more than a year ago*, the glass only recently has become available commercially. It will be remembered that Coolite is a heat-absorbing, ribbed glass conforming to Federal Specifications DDG—451, E9, Type H. It transmits only 27 per cent of the solar infra-red (heat) rays, and yet permits passage of 68 per cent of the light rays. Considered competitively, this means that Coolite gives a more effective combination of minimum heat and maximum light than standard glass of this kind. Other advantages are its pleasing blue-green color, which will not fade, and its ability to withstand sudden atmospheric changes without fracturing. Because of its comparatively low cost, Coolite offers possibilities for extensive application in building, and suggests to the architect the use of glass where it might not otherwise be used. Shingles, for example, are made of Coolite, permitting the use of skylights in roofs without architectural disfigurements; in fact, the blue-green color of the glass makes it practically indistinguishable in a slate roof. Or an entire section of a roof may be shingled in glass, lighting up the interior of a dark attic room and still keeping the air relatively cool and comfortable.

* Transactions of the Illuminating Engineering Society, 1933.

WORLD'S LARGEST TELESCOPE MIRROR OF FORTY YEARS AGO

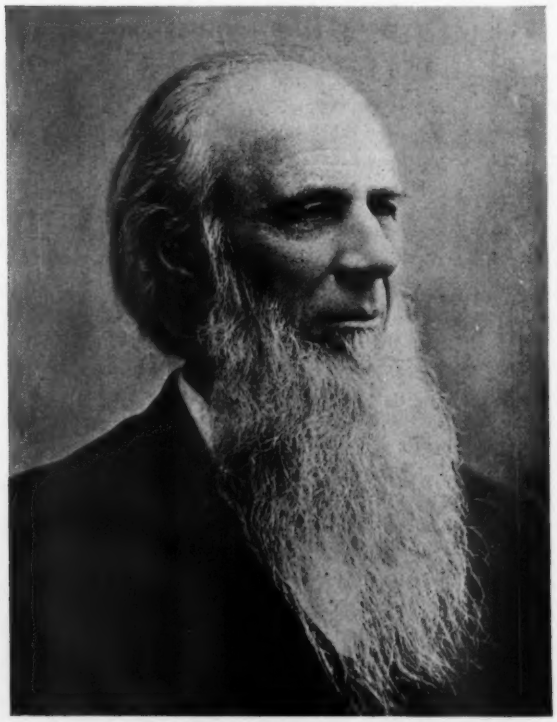
By FRANK W. PRESTON

THIS year, 1935, April 19 occurred on a Friday; Good Friday, in fact. It also fell on a Friday forty years ago, in 1895, and on that date (as nearly as can be ascertained) there was cast in Western Pennsylvania the world's largest telescope mirror. Three years later, when that mirror had been completely ground and polished, America held the world's record for the only time. All subsequent great telescope "lenses" were of European glass till very recent times.

More than a generation was to pass away before America would again attempt to make the world's largest telescope object glass: in fact at this moment it has not yet been done, and will not be done until the great mirror now cooling at Corning is taken to California and ground and polished to shape.

The present Corning mirrors are being made by the staff of the most scientific glass works in the world: they will be ground and polished by professionals of the world's premier observatory at Mount Wilson: they are being financed by the Rockefeller Foundation and other immense sources of wealth. Thousands of people went to see the casting of the first 200″ disc, and the whole world has been watching its progress.

But the great mirror of 1895 was cast by a young graduate of Cornell, scarcely a year out of college, and it was ground and polished single handed in three years of work by a man nearly eighty years of age. And when it was finished it was as nearly perfect as anything of human manufacture can be, and the work of making it is probably the finest and most exacting that men ever attempt. The total cost was two or three thousand dollars and even that was hard to raise.



John Peate, preacher and craftsman.

It is a strange, heroic, and yet pitiful story; a story, however, that is repeated thousands of times in this preoccupied world; a story of immense technical difficulties finally overcome by courage, genius, and patience, in spite of the most slender resources, and then failure and oblivion from the world's indifference and inability to recognize its opportunity.

It was ninety-nine years ago that John Peate settled in Buffalo, a lad of sixteen, born in Ireland. There he learnt the trade of a bricklayer, and in later years he used to pat affectionately the brick walls of Buffalo buildings he had erected. It is ninety years since Peate married, in Buffalo, Mary Elizabeth Tilden, a relative of President Fillmore. It was forty years this month since the great "lens" was cast by the Standard Plate Glass Company, and thirty-seven since it was finished at Greenville, Pa. and shipped to Washington, D. C.

As a craftsman Peate has rarely or never been excelled. Nor has the world often seen a man of such abundant energy, for he walked twenty or thirty miles a day when long past seventy, went swimming in the whirlpool of Niagara when nearly eighty, and went skating when past eighty. To chip and grind and polish more than five hundred pounds of glass from the great disc was all in the day's work to him, and to polish and figure it to one hundred-thousandth part of an inch over all its vast surface was a task that did not daunt him.

In his early twenties Peate decided to become a Methodist preacher, and he was licensed to preach at the age of twenty-nine. For thirty or forty years he was in charge of churches in the district which the Methodist-Episcopal Church knows as the Erie Conference. The hills above Chautauqua have scarcely yet forgotten the fervor of his early preaching, and the Pymatuning country treasures his memory as a grand old man.

As the time for his superannuation began to draw near, Peate became a little distressed. "What am I to do all the rest of my life?" he asked. "Oh, make a big telescope," said one of his colleagues, Dr. Wythe. "Here's a pamphlet that tells you how to do it." Peate read the pamphlet and immediately started to work: he had ten or fifteen years to go before his superannuation. He made a 3″ lens and then a 6″ one. The latter he mounted in a telescope, and erected a little observatory at his home in Greenville, but he was more interested in making telescopes than in using them. He knew the skill that was in his hands, and that many men could use big telescopes, but very few could make them. Patience and skill of the highest order were necessary to shape big telescope lenses with accuracy.

Beyond a size of about 6″ diameter, the glass for lenses proper becomes very expensive, and, apart from that, the thickening glass absorbs some of the light. It is better to use a mirror, which is a disc of glass on which a parabolic dish is ground and polished. This surface is then silvered to increase the reflection, and the light is

reflected from it and focussed by the parabolic shape, without going through the glass at all. Glass, rather than metal, is used, not because the glass is transparent, but because it can be worked to extreme accuracy and because the shape, once made, is permanent.

So Peate began making mirrors, 8″, 10″, 12″, 15″, until he had reached a 32″ size. One of these mirrors found service in India, but most of them in the United States, though at present we have lost track of many of them. By 1893 he had made thirteen of them, each a long, delicate, slow business, for the heat generated in polishing the glass distorts it, and the mirror must be allowed a long time to cool down again before a further test can be made of its shape.

In 1893 the Methodist-Episcopal Church obtained a charter for a new university at Washington, D. C., to be called the American University. Its first chancellor was Bishop Hurst, and this Bishop was sent to Dubois in September of that year to preside at the annual meeting of the Erie Conference. At that meeting Peate, who was due for superannuation the next year, announced "If you will give me the glass and other materials, I will make the biggest telescope lens in the world for the new University."

"Well, how big can you make it?" asked the Bishop.

"Oh, as big as that map on the wall", said Peate, mentioning the first thing that caught his eye.

"Measure the map," said the Bishop. It was 62″ across.

"All right," said the Bishop, "make us a 62″ mirror."

This was far bigger than any telescope in the world in those days, except for Lord Ross' big reflector in Ireland. This was a metal one, and was not a great success, and in fact was not in use. There were only three men in America in those days capable of making telescope mirrors; one was John Brashear of Pittsburgh, another perhaps Alvan Clark of Massachussets, and the third was John Peate, then seventy-three years of age.

University professors vied with glass manufacturers and trade journals in declaring such a lens impossible. They poured ridicule on Peate, that "superannuated itinerant preacher", and on George Howard and the Standard Plate of Butler when they agreed to try to make it. "Butler may be all right for mud, buckwheat and crude oil", said the henchman of the Plate Glass trust in his editorials, "but its reputation for satisfactorily annealing lenses is yet to be established: no-one but a superannuated itinerant preacher would have thought of going to Butler anyhow." And every time the Butler company failed in its early attempts, the wilder the screams of joy from the baleful prognosticator.

In April, 1895 however, the Standard Plate Glass Company made the disc successfully, and Peate went to inspect it.

"Lend me a hammer," he said, and grabbing a hatchet that stood by, he neatly whacked off the tail or sprue that is naturally left by the casting process, while everyone's else heart went into his mouth.

"That's no use; can't do with that," said Peate, referring to the tail. Then he pronounced the disc perfect and had it shipped to Greenville. There with apparatus and machinery of his own devising, he ground and polished the glass. It took him two years or more.

He could not work in the winter, because there was no means of heating his workshop uniformly. He could not work in the heat of the summer midday, for the atmosphere was too turbulent. But in the early mornings and late evenings he worked away, continually testing the great disc.

George Howard, from a picture taken in 1895. Howard is still with us, a consulting engineer to the Hartford-Empire Company and a resident of Butler. Without Howard, Peate would probably never have had a "lens" blank to work on.

As the thing neared perfection he liked to show his friends how delicate it was. From a table 60 or 70 feet away, the light of a sperm candle was reflected back to the visitor's eye, and the great disc looked like a ball of fire, evenly lit all over. Then Peate would hold his fingers near the glass, without touching it, and soon that part of the surface would stand up in a bump like a mountain on the moon. The warmth of his finger had swollen the glass in its immediate neighborhood.

Peate wore a patriarchal beard of long white whiskers, and sometimes he would pull out a whisker and lay it on a distant fence, and then examine it with his telescope. Then further off, across the valley, was an apple orchard, and Peate used to turn his telescope on the apples and study them, or show them to visitors. Finally, in the late spring of 1898 the great mirror was finished. Peate took it out of doors and climbing up a ladder, used it as a telescope to look at the heavens. He saw stars he had never seen before, stars perhaps that no-one had ever seen before; and then he boxed it up in special fittings of his own design, and shipped it to the University at Washington when he was over seventy-eight years of age.

The University appealed for funds to mount it in a telescope, but no-one came to the rescue. The great telescope was to be a memorial to the old circuit rider, a vastly more fitting memorial than any costly shaft of stone. But the appeals went unheeded. Peate died in 1903 and his lens stood all but forgotten for thirty years more. This last year (1934) the officials of Corning Glass Works have been instrumental in getting it moved to the great museum of the Smithsonian Institute, where the experts of the Geophysical Laboratory and of Mount Wilson Observatory have been to see it and marvel at that old man's skill. "Properly mounted," said one of them, "that mirror could be used with perfect satisfaction today."

MATERIALS FOR GLASS MOLDS

A GENERAL discussion of the advantages and disadvantages of glass mold materials requires that the properties desired of the material for the equipment be fully understood first. The more important requisites of a glass mold material may be tabulated in brief as follows:

1. The material should be close grained and of a uniform texture. Such a material may be easily worked up into a mold possessing a highly polished smooth surface. This mold surface will produce good glass surfaces and will tend to prevent undue sticking of the glass to it.

2. Although the maximum mold temperature encountered in commercial practice is rarely over 1000°F, there is a danger of overheating the mold equipment during the warming-up period. The material should therefore be able to resist pitting and scaling even when operated at temperatures around 1500°F.

3. The material should not warp or show excessive growth during use at normal operating temperatures. Excessive growth causes distortion and cracking of the mold surface.

4. The thermal conductivity of the material should be high. A material with a high conductivity will run at lower temperatures than a material possessing a low thermal conductivity, other factors being equal.

5. The material should be easily machinable by both hand and machine methods.

6. The material must be economical. The life of the mold must justify the first cost of the material and the cost of working it up into the finished mold.

Cast iron, as supplied by the ordinary foundry, meets the high thermal conductivity and economical cost requirements very satisfactorily. However, many of the cast irons supplied to the glass trade give considerable trouble insofar as close grain and machinability are concerned. These properties depend upon the physical make-up of the iron. If the iron contains an excessive amount of carbon in the combined form, the structure of the iron approaches that of a white cast iron and is extremely hard and difficult to machine. Such a structure however gives iron that will take a high polish in addition to producing edges that are both sharp and hard. On the other hand, with an excessive amount of carbon in the form of graphite, the iron is soft; and although easily machinable, its surface is so porous that a smooth highly polished surface is difficult and often impossible to obtain. A satisfactory iron, as far as these two factors are concerned, must combine the best features of both.

The ideal iron for workability and texture is one in which the precentage of graphitic carbon is as low as possible but sufficient for machinablity. The graphite present should be evenly distributed in the form of small particles. This condition may be attained in the foundry by chilling or by chemical control of the composition. Chilling the casting, if correctly done, improves the iron by preventing the separation of large flaky graphite particles in the region affected by the chill. The chilled area, when examined microscopically, appears close grained and consists of fine particles of graphite uniformly distributed in a pearlite, cementite structure. This structure approaches that of a white iron. Excessive machining of this chilled area should be avoided as the removal of the chill defeats its purpose. This is an important point to bear in mind when designing mold castings that require excessive machining.

By exerting close control over the chemical composition of the metal it is possible to prevent the separation of excess flaky graphite particles in the casting. In this connection, silicon is by far the worst offender, since it decreases the solubility of carbon in the iron.

Several foundries are now producing this type of cast iron on a production basis, and are supplying the trade with a suitable iron that does not vary from melt to melt. This is particularly true of those foundries that make a specialty of glass mold castings. In many foundries glass mold iron is only a small fraction of the total tonnage and when an order for mold castings is received, the castings may be poured, for example, from a metal that is being used for furnace grate bars.

Iron which has fine, well-distributed graphite flakes will suffer less from growth, cracking and scaling than iron containing large unevenly distributed graphite flakes, even though the chemical composition of the two irons may be the same. Even with such a structure, considerable growth, cracking and scaling will be evidenced due to the decomposition of the combined carbon into ferrite and graphite and the resulting oxidation of the graphite so formed.

In an effort to entirely eliminate or reduce to a minimum these defects of ordinary cast iron, several alloy cast irons have been developed. The addition of small amounts of nickel to the metal results in a denser and finer grained casting with less growth. Chromium acts in a similar manner. Additions of over 1 per cent chromium to the metal increases the stability of the carbide and thereby minimizes the volume change and graphitisation resulting from the decomposition of the combined carbon. Alloy cast irons containing 1 to 32 per cent Cr; 1 to 10 per cent N or combinations of nickel and chromium are now on the market. While all of these alloys exhibit much less growth, cracking and scaling than ordinary cast iron many of them are difficult to machine, and their thermal conductivity is lower.

The British Cast Iron Research Association has developed and patented two series of alloy cast irons that seem to offer distinct possibilities as glass mold irons. The first of these two series is "Silal" which contains about 2.5 per cent total carbon and between 4 and 10

TABLE I*

Material	Temperature at which Serious Deterioration occurs (Growth & Scaling) °C	Appreciable Scaling Occurs °C	Recommended Maximum Temp. for Practical use °C
Ordinary Cast Iron	500	500	450
Pearlitic Cast Iron	650	500	550
1% Cr Cast Iron	750	550	600
"Silal"	900	800	750
"Nicrosilal" ..... over	1000	900	950

* N. P. Inglis, Jour. Soc. Glass Tech., Vol. XVII; No. 68, p. 366.

per cent silicon. The structure of this iron consists entirely of ferrite, small well dispersed graphite flakes and very little combined carbon. The second iron, "Nicrosilal", has a composition approximately as follows: Ni 18 per cent, Si 6 per cent, Cr 2 per cent, C 1.8 per cent, Mn 1 per cent; it is made in both hard and soft grades by varying the alloying elements. "Nicrosilal" is less brittle, more machinable and can be used at higher temperatures than "Silal". A comparison of the growth and scaling characteristics of these two irons and other cast irons is shown in Table 1.

Many alloy steels have been tried and, in some cases, are being used with success as mold materials. While most alloy steels are more expensive, difficult to machine and have a thermal conductivity much lower than cast iron, their freedom from growth, resistance to scaling and corrosion and the smooth finish obtainable warrant continued investigation as to their possibilities. Alloy steels have been used with success for pressed ware mold equipment; their compositions varied as follows: Cr 10 to 15 per cent; Cr 10 to 15 per cent, Co 2 to 5 per cent; Cr 8 to 13 per cent, Si 3 to 4 per cent; Cr 17 per cent, Ni 37 per cent; Cr 18 to 20 per cent, Ni 6 to 10 per cent; Cr 2 per cent, Ni 15 per cent; Cu 6 per cent. These alloys are especially useful when high fabricating temperatures are required. Attempts have also been made to use such alloys as plungers in press and blow and blow-blow equipment.

TABLE II. (after G. Gehehoff*)

MATERIAL	STICKING TEMPERATURE °C LEAD GLASS	SODA-POTASH GLASS
Grey Cast Iron	555	605
Steel V5m	525	615
Steel V2a	530	610
Steel B	520	575
Steel B7Mo	515	590
Steel E	525	565
Steel Co	520	595
Cr Plated Iron	560	625

*Jour. Soc. Glass Tech. Proceedings Vol. XII, No. 48 p. 145-158.

TABLE III. Specific Heat and Thermal Conductivity of Various Mold Materials

Material	Composition	Specific Heat	Thermal Conductivity
Cast Iron	C 2%	0.11	0.09-0.12
V5M	C O. 15%, Cr 15% .. Ni 0.8%	0.11	0.07
Nichrome IV	Ni 80%, Cr 20%	0.11	0.05
Indilatans	C O. 1%, Ni 36%	0.12	0.04
V2A	C O. 2% Cr 20% ... Ni 7%	0.12	0.04
Alit	Al 15%, Fe 85%	0.13	0.03
USS 12		0.11	0.06
USS 27		0.11	0.05
USS 18-8		0.12	0.04

Table II gives a comparison of the sticking temperatures of two glasses and various alloys. Quoting Dr. Gehehoff: "As far as sticking goes, the costly materials differ slightly from each other and even behave worse than the common grey cast iron . . . It must be kept in mind that mold material suffers great mechanical wearing away, for example, by pressing and also marked corrosion by hot glass and hot gas. Costly steels behave better than inferior ones in this respect."

©Wide World Photos

HOW WOULD YOU LIKE TO MAKE THESE GLASSES?

The red lines shown in these glasses are compulsory on all glasses used in German bars or restaurants. They indicate the filling level of a half portion, should the customer not desire to order a full glass. And here is something for the glass manufacturer to ponder—all glasses must be tested to make sure that the markings indicate a true and uniform capacity.

NEWS

BALTIMORE-WASHINGTON SECTION

The Baltimore-Washington Section of the American Ceramic Society held a meeting in Baltimore on May 11. About 42 members attended and visited the Walter's Art Gallery, where rare and valuable glass, pottery, enamels and other ceramic art treasures were on display. J. P. Smyth gave an excellent talk on "Art and Ceramics from a Collector's Viewpoint." He was followed by Richard B. Schmitt, S. J., Loyala College, who spoke about "Micro-Analytical Methods and Their Possible Uses in Ceramics." Father Schmitt is a specialist in this field and is in charge of one of the most completely equipped microchemical laboratories in this country.

NEW FEDERAL SPECIFICATIONS

The Federal Specifications Board of the Treasury Department has adopted tentative purchase specifications for glass volumetric apparatus. These have been set forth in great detail in mimeographed form for inspection by manufacturers of this type of equipment, who are invited to send in their comment or criticism. Copies of the tentative specifications may be had by addressing the Board at Room 735, Federal Warehouse, Washington, D. C. To receive attention from the several technical committees, suggestions must reach them by June 19.

APRIL PLATE GLASS PRODUCTION

The production of Polished Plate Glass by member Companies of the Plate Glass Manufacturers Association for the month of April, 1935, was 16,998,914 sq. ft., as compared to 16,531,950 sq. ft. produced in the preceding month, March, 1935.

OVERMYERS SUSTAIN INJURIES

A broken rib and a sprained shoulder were the consequences of a bad fall sustained by C. P. Overmyer, president of Overmyer Mould Company, at his Greensburg, Pa., office on May 5. Mr. Overmyer was at once removed to the Westmoreland Hospital, near Greensburg, where he was confined for nearly two weeks. He was then able to return to Winchester, though unable to resume active duties almost until the first of June. This mishap has naturally delayed Mr. Overmyer's trip to the Coast.

While his father was flat on his back in the Greensburg hospital, Chet Overmyer took the count at White Sulphur Springs. While warming up for the GCA golf tournament in a practice round, he was hit in the foot with a golf ball. Fortunately, the Greenbriar Hotel has a full complement of sulphur baths, mud packs, etc., but not all their ministrations could replace the bone that had been chipped away. This probably was the reason Chet made such poor time driving to Cincinnati Friday —a distance well over 400 miles was covered by him in seven hours flat.

Italy has begun the manufacture of optical glass. Parra-Mantois, prominent French manufacturing firm of optical glass, assisted in launching the undertaking.

NEW FREIGHT RATES FOR CONTAINERS

Effective July 1st, 1935, the carload rates on glass containers between all points in Official territory will become 27½ per cent of the 1st class rates. The description of the articles will correspond to the description in the present glass container tariffs and the minimum carload rate will be 30,000 lbs. The new basis was adopted because of truck competition and will supersede existing rates.

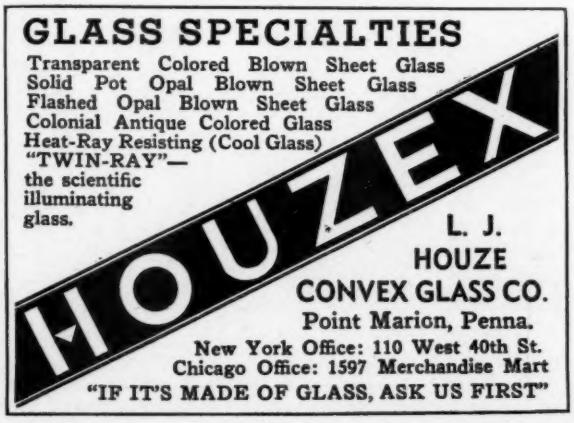
PLATE GLASS OUTLOOK OPTIMISTIC

Directors of the Pittsburgh Plate Glass Company at the regular meeting held in New York, May 16, declared the regular quarterly dividend of 50 cents a share. H. S. Wherrett, President, expressed continued optimism over business conditions. Continued high production in the automotive field and the increasing use of safety glass as standard equipment is reflected by heavy manufacturing schedules. He further stated that the general increase of building operations, both commercial and residential, should influence favorably the sale of the Company's paint and glass products.

Heating the Mississippi to melt ice is the latest thing in dam engineering. No, this is not a dirty dig at the PWA. Just a publicity release from General Electric, which is installing giant "electric toasters" in a dam near Canton, Mo., so that the gates will work during cold weather.

GLASS AT PREMIUM CONVENTION

The importance of glass in the premium field was given forceful emphasis at the recent National Premium Buyers Exposition, held in Chicago at the Palmer House early in May under the auspices of the American Premium Advertising Association of America. Among the companies exhibiting were: Hazel-Atlas Glass Co., with extensive lines of glassware and opalite; Macbeth Evans Glass Co., with Monax tableware, glass luncheon and dinner sets, chip-proof beverage glasses, tea sets, and Crystal Chef glass coffee makers; Owens-Illinois Glass Co., displaying many re-sale items, including glass rolling pins, iced-tea sets, salt and pepper shakers, and other novelties; and Federal Glass Co. with the company's full line of premium glassware.



WITH THE CERAMIC COLLEGES

ALFRED UNIVERSITY OFFERS SUMMER SCHOOL IN CERAMICS

The N. Y. State College of Ceramics of Alfred University will offer courses of study this summer in all the branches of ceramics. These courses include ceramic art, glass technology, enamels, X Ray analysis, petrography, whiteware technology and the general technology of ceramic materials and products. Courses in surveying, weaving, jewelry, and the liberal arts subjects of mathematics, chemistry, languages, economics and physics are also included.

The work will be given by the regular staff of the college and all the library and laboratory facilities of the institution will be available.

Due to its location and altitude, the weather at Alfred during the summer is most pleasant. Excessive heat is practically unknown. Golf, swimming and other recreational facilities are available within short distances. Tennis courts and baseball diamonds are available on the campus. Detailed information may be obtained by writing to W. A. Titsworth, Director of the Summer School, Alfred, N. Y.

ILLINOIS UNIVERSITY HOLDS CONFERENCE ON GLASS PROBLEMS

A Third Conference on Glass Problems was held on May 31 and June 1 at the Department of Ceramic Engineering of the University of Illinois. The meeting was devoted to a consideration of some of the practical aspects of glass works operation. The following papers were read: "The Use of Cullet in The Glass Industry," by C. J. Uhrmann, Peltier Glass Co. (Following this paper, Professor Parmelee read a report of a questionnaire which he recently submitted to the glass industry on the use of cullet); "The Heating Up of Glass Tanks," by Z. C. Kline, General Electric Co; "Application of Special Refractories in Glass Furnaces," by M. C. Booze, Charles Taylor Sons Co; "Report of Progress in Glass Research in the Department of Ceramic Engineering," by Professor C. W. Parmelee. This summary dealt with the effects of alumina on the following properties of glass: *Rate of Melting* (W. B. Silverman), *Scratch Hardness of Surface* (K. C. Lyon), *Thermal Expansion* (J. J. Theodore), *Surface Tension* (C. G. Harmon), *Tensile Strength* (A. E. Badger and W. B. Silverman), and *General Melting Phenomena* (W. S. Debenham). The first day's program was followed by an informal dinner, and in the evening by a lecture on "The Land of the Midnight Sun," by Professor A. R. Cain.

The concluding session on Saturday morning was featured by papers on the following subjects: "The Principles of Heat Transmission and Insulation of Furnace Walls," by R. K. Hursh, Owens-Illinois Glass Co., "Insulation of High Temperature Furnaces," by R. S. Barber, Johns Manville Co., "Considerations in Applying Insulation," by R. S. Moore, Harbison-Walker Refractories Co., "Insulation of Glass Furnace Requirements," by J. E. McBurney, Owens-Illinois Glass Co. This program concluded with a report presented by A. E. Badger on a questionnaire submitted to the glass industry regarding furnace insulation.

PAYS TRIBUTE TO THE GLASS CHEMIST

"The Contribution of the Chemist to The Glass Industry for the Advancement of Modern Civilization" is the title of a paper contributed by Dr. Alexander Silverman, University of Pittsburgh, to the April number of *The Chemist*. This periodical is the publication of the American Institute of Chemists, which this year is celebrating the Tercentenary of the chemical industry in America. The April number of *The Chemist* constitutes a symposium in which individuals of prominence have recorded the contribution which the chemists of their industry have made for the advancement of civilization.

STUDENT ACTIVITIES AT ALFRED

One thousand dollars a year was added to the treasury of the American Society by vote of the Board of Trustees of Alfred University, who recently have ordered that all engineering students of the Ceramic College must become active members of the Society. The membership is 204. Dues $5.00.

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In February about sixty students took an active part in putting over the Buffalo meeting of the A. C. S., acting as guides, messengers and projector operators. Under the leadership of Andrew J. Fedor, student chairman, the group also acted as hosts to student delegations from other colleges and sponsored a general get-together.

Returning from the convention, certain students delegated to cover the several functions at the convention, made their reports. This same meeting was featured by an address by Thomas S. Curtiss, of Curtiss Laboratories, Los Angeles, who spoke on "Modern Trends in Ceramics."

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The monthly meeting in March was addressed by Donald Hagar, on the subject of "Raw Materials for the Ceramic Industry." Mr. Hagar laid special emphasis on white wares.

An outstanding event at Alfred University is the annual festival of St. Patrick—the patron saint of engineers. A two-day celebration featured an "Open House," at which all the laboratories are in operation and students at their regular tasks under the supervision of instructors. This "Open House" serves to familiarize the general public with the nature of ceramics and suggests a possible life work to prospective students. About 1,000 visitors attended this year. Twenty seniors were knighted with the Order of St. Patrick, and in addition: Hon. John J. Merrill, N. Y. State Tax Commissioner, active in founding the college; Ross C. Purdy, General Secretary of the A. C. S; Roland W. Clark and Forrest H. Teft, Ceramic Engineers.

. . .

Elections to Keramos included (seniors) Kenneth Greene, Joseph C. Richmond, William S. Hawkes; (juniors) Stuart Schatz, John Nevins, Robert Murray, Edwin Phillips and Curtis Jackson.

MAIL BAG

ABOUT HEATING UP GLASS TANKS

Editor, GLASS INDUSTRY:

I would like to present some questions and comments on the recent excellent article "Heating up Glass Tanks" by J. Gavin Callinan.

On page 134: "If any wide cracks are discovered they must be cleaned out and covered with a piece of strap iron." Is this iron permitted to remain in the tank or is it later removed?

The 10 day period for heating is generally used in the industry but I've found a somewhat different schedule used with success in heating a number of tanks and I wonder if Mr. Callinan will explain his reasons for slowing up the heating rate at the end of the period. A comparison of the schedule I've found and Mr. Callinan's is as follows:

	Mr. Callinan	*Suggested*
End of the 1st day	250	150
2nd "	600	325
3rd "	930	550
4th "	1100	700
5th "	1630	1000
6th "	2240	1300
7th "	2340	1700
8th "	2550	2100
9th "	2580	2600

I have always thought that most of the expansion was out at 1300 and have always speeded up the heating rate at that time as the schedule shows. These figures are for tanks of 50 tons or less daily capacity.

Concerning the expansion of the silica brickwork the ¾ to 1" expansion seems in excess of the amount I have found which is ⅛" per foot. Expansion joints in the sidewalls and the crowns with this allowance usually close almost entirely and there is only a small amount of "mudding up" to be done when the tank is heated.

Where possible I've always found it desirable to use a long base metal thermocouple rather than the bare metal couple up to 1300 F because of the closer check which is possible. If at all possible a continuous recording pyrometer is desirable to enable the operator to watch the rate of rise and to have an indisputable record of the temperatures during the heating up period.

JOSEPH EARLY

Answering Mr. Early's inquiries:

Referring to the covering of wide bottom cracks with pieces of strap iron, this is done on the outside of the tank. The iron is held up against the joint or crack with the help of the regular bottom ironwork and is permitted to remain there.

The heating schedule given by Mr. Early is good. The term "schedule" as applied to my figures is really a misnomer as it will be noted that I said—" . . . . these were the actual temperatures as taken. . " and " . . . . deviations were made from ideal schedules as circumstances arose." I do not have the log of that particular heat-up available but it is likely that there was a good reason for the very small temperature gain from the sixth to the seventh day and the consequent loss of twenty-four hours time.

I heated up a 964 ton tank not so long ago whose heat-up from the time the fires were lit to the time production commenced required twenty-eight days. For reasons not connected with the factory we started on a slow schedule, then held our fire several times and once began to cool off preparatory to a complete shut-down. At 4 P. M. one day I had reached a temperature of about 1620° F. and had put on the regular port burners using natural gas. At 8 P. M. I received word to shut down cold and then on the following day I was instructed to hold what temperature I had remaining. Finally after fourteen more days we began production.

I adjust schedules as the heat-up progresses and usually I am more fortunate than in the above extreme case in that I am able to speed up in order to get into production.

The expansion for silica brick at ¾ to 1 inch per *five* feet is perhaps a little in excess of that usually found though the bricks I had in mind at the time (95.91% SiO_2) had an expansion of 1.25% (see figures 4 and 5) which would be ¾ inch per five feet and Harbison-Walker Refractories Company give a figure of about 15/16 inch in five feet.

I am in hearty agreement with Mr. Early as to the desirability of using base metal couples in the lower temperature range. On the larger tanks—whose inside dimensions are as much as 29 feet by 120 feet—I use as many couples as can be conveniently read by the help at hand. I heat up the noble metal couples and their protecting sheaths along with the tank and read them as a check on the more responsive and sensitive base metal couples until the temperature passes 1500° F. or, as the case might be, it passes the range of the instrument on hand and then I remove the base metal couples before they are ruined. I have found that a noble metal couple within porcelain primary and secondary tubes will lag about 100° F. behind a bare base metal couple.

Continuous recorders are certainly desirable and in most cases I have been able to use them from the very start of the heat-up, generally by switching in a base metal pyrometer recorder borrowed from the gas producers or the kilns or lehrs.

J. GAVIN CALLINAN.

NEW BULLETINS

Methods of Testing Thermocouples and Thermocouple Materials. Research Paper RP768, Journal of Research, National Bureau of Standards, 14, March 1935. By W. F. Roeser and H. T. Wensel.

This paper describes various methods used for testing thermocouples and thermocouple materials, and the precautions which must be observed in order to attain various degrees of accuracy. In particular, it describes in detail the methods developed and used at the National Bureau of Standards. It also provides some guidance to the reader in the selection of the method which is best adapted to a given set of conditions.

"Either you get rid of those hiccups or you're fired".—Reproduced from the Saturday Evening Post by special permission of the copyright owners, The Curtis Publishing Company.

EQUIPMENT AND SUPPLIES

BROWN INSTRUMENT AND MINNEAPOLIS-HONEYWELL OPEN JOINT OFFICE

The Brown Instrument Company, Philadelphia, manufacturers of instruments and controls, and the Minneapolis-Honeywell Regulator Company, Minneapolis, manufacturers of control systems and regulators, have opened joint offices at 101 Marietta Street, Atlanta, to serve the southeast. Wesley R. Moore, for a number of years District Manager of Brown Instrument, is in charge.

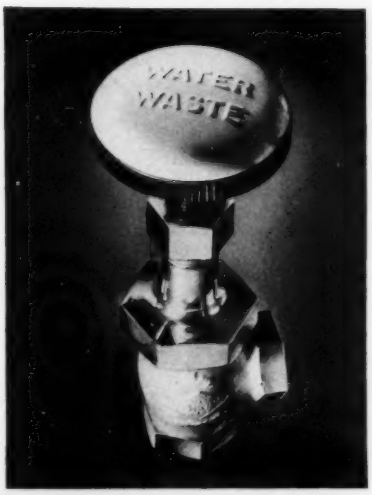
A sales and installation service will be maintained at this office for the complete lines of both companies.

COLOR INDEXED VALVES

Color is an indexing device of proved value. Its flashing signal that gets instant recognition has been employed in many ways to banish doubt and prevent errors and delays. Now, we find it applied to valves in the form of a new type of valve wheel which is molded of colored plastic materials.

This new wheel which was developed by Jenkins Bros. for special use on their valves makes it possible to designate valves for steam, water, air or any other fluids and gases by distinctive colors. Five standard colors—blue, red, black, green and gray—are offered, unmarked or with five standard service markings molded in relief. Jenkins also offers to make up wheels of special color or with special markings.

In the descriptive bulletin on these Jenkins Colored Wheels, the maker claims that they are strong, cool to the touch, easy to grasp, sanitary, permanent in color and unusually pleasing in appearance.



IMPROVED FLEXIBLE BELTING

Acme Steel Company, Chicago, announces an improved type of construction for their open mesh, flexible, steel conveyor belts. These belts are composed of formed spindles of flat steel, connected by pivot rods. In the old type of construction, the rods were strung through round holes, and the edge of the hole provided the only bearing for the rod. The new design, which reduces the wear of the rods, makes the hole elongated to a point where the entire flat surface of the U shaped section is utilized as a bearing.

This construction is illustrated in the accompanying sketch; A showing the elongation of the holes, and B the pivot rod now resting against the entire flat surface of the U shaped section. The change in design is said by the manufacturers to result not only in reducing wear, and hence adding to the life of the belt, but also in its increased flexibility and smoother operation.

GENERAL REFRACTORIES APPOINTS DEALER AGENTS

General Refractories Company, Philadelphia, announces the appointment of two new dealer agents—the Broadway Manufacturing Company, Knoxville, Tenn., to serve the Knoxville area, and Shadbolt and Boyd Company, Milwaukee, for that territory. Both of the new dealer agents will carry a complete stock of the company's refractories.

NEW, LIGHT REFRACTORY CONCRETE

A new type of Firecrete for casting light-weight refractory concrete on the job has just been announced by Johns-Manville. Known as L. W. (Light-Weight) Firecrete, this new product is composed chiefly of high alumina clay calcined at high temperatures. The resulting concrete weighs only 75 lbs. per cu. ft. Under continuous operation at 2400°F., shrinkage is so slight as to be entirely negligible. It has withstood the most severe alternate heating and cooling tests without spalling.

L. W. Firecrete is 40 per cent lighter than fire brick and has 40 per cent lower heat storage capacity. This feature is of particular importance on intermittent furnaces which can be brought up to temperature in a much shorter time with less waste of heat each time the furnace cools. Because the thermal conductivity of the new material is considerably less than half that of fire brick, radiation losses are also reduced.

The material is particularly recommended for casting lightweight refractory shapes and for furnace doors and floors. It can be put in service after from 12 to 24 hours air-curing.

The Adjustable Clamp Co., Chicago, announces a new line of miniature "C" clamps, made with one inch depth of throat and opening one to two inches.

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	...	.29
Hydrochloric (HCl) 20° tanks	Per 100 lb.	...	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	...	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 130 lb. carboy ext.	Per 100 lb.	...	5.50
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	...
Tartaric	lb.	...	Po. or Gr. .25 / Cry. .25½
Alcohol, denatured, 50 gal. drum	gal.	...	.56½
Aluminum hydrate (Al (OH)₃)	lb.	.04-.04½	.04½-.05
Aluminum oxide (Al_2O_3)	lb.	.04	.05
Ammonium bicarbonate (f.o.b. works)	lb.	.0515	...
(f.o.b. N. Y.)	lb.	...	.0571
Ammonium bifluoride (NH_4FHF)	lb.	...	.15
Ammonium nitrate (NH_4NO_3)	lb.	...	.08
Ammonia water (NH_4OH) 26° drums	lb.	...	.02¾
Antimonate of Sodium	lb.	...	.10½
Antimony oxide (Sb_2O_3)	lb.	...	.12¼
Antimony sulphide (Sb_2S_3)	lb.	...	.11
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.03½	.04-.04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	40.00	45.00
90% through 100 mesh	ton	37.00	...
Barium hydrate ($Ba(OH)_2$)	lb.	.049	.05½
Barium nitrate ($Ba(NO_3)_2$)	lb.	...	.07¾
Barium selenite ($BaSeO_3$)	lb.	...	1.50-1.75
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Bone ash	lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	...	...
Granulated	In bags, lb.	.02	.02¼-.02½
Powdered	In bags, lb.	.02¼	.02½-.02¾
Boric acid (H_3BO_3) granulated	In bags, lb.	.04¼	.04½-.04¾
Cadmium sulphide (CdS)—	lb.	...	.70-.75
Calcium phosphate ($Ca_3(PO_4)_2$)	lb.	.07	.07½
Chromite	lb.	...	.0215
Cerium hydrate 100 lb. drums and 600 lb. barrels	lb.	...	.65
Chrome Oxide Green, 400 lb. bbls.	lb.	.17	.215-.25
Cobalt oxide (Co_3O_4) In bbls.	lb	..	1.25
In 10 lb. tins	lb.	...	1.35
Copper oxide Red (Cu_2O)	lb.	...	.25
Black (CuO)	lb.	...	.15
Black prepared	lb.	...	.22
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.08½	.09
Synthetic (Artificial)	lb.	.08½	.09
Epsom salts ($MgSO_4$) (imported) technical	Per 100 lb.	...	2.30
Feldspar—			
20 mesh	ton	11.00-13.25	
40 mesh	ton	11.50-13.75	
Granular	ton	11.75-14.00	
Semi-granular	ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	25.23	...
In bags	ton	26.83	38.00-40.60
Formaldehyde, bbls.	lb.	...	.07
Graphite (C)	lb.	...	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	...	.0425
Black (Fe_3O_4)	lb.	.04½	...
Iron chromate	lb.	..	.035-.05
Kaolin (f. o. b. mine)	ton	8.00-9.00	...
English, lump, f. o. b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	...	.16
Lead oxide (Pb_3O_4) (red lead) (N. Y.)	lb.	.0675	...
In 5 Ton lots	lb.	...	.0725
Less than 5 Tons	lb.	...	.0775

		Carlots	Less Carlots
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	10.50	...
Burnt (CaO) ground, in bulk	ton	7.00	...
Burnt, ground, in paper sacks	ton	9.00	...
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.25	2.25
Limestone ($CaCO_3$)	ton	1.75-2.50	...
Litharge (PbO) (New York Prices)	lb.	.0575	...
In 5 Ton lots	lb.	...	.0625
Less than 5 Tons	lb.	...	.0675
Magnesium carbonate ($MgCO_3$)	lb.	.06	.08-.09
Magnesium sulphate (U.S.P.)	lb.	...	.03
Manganese, Black Oxide In Paper bags	ton	45.00	50.00
In Burlap bags	ton	46.50	51.50
In Casks	ton	48.00	53.00
Neodymidm oxalate, 50 lb. drums	lb.	...	5.00
Nickel oxide (Ni_2O_3), black	lb.	...	.35-.40
Nickel monoxide (NiO), green	lb.	...	.35-.40
Plaster of Paris, bags	ton	31.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)— Crystals	lb.	...	.08⅝
Powdered	lb.	...	.09⅝
Potassium carbonate Calcined (K_2CO_3) 96-98%	lb.	.07⅛	.07⅛
Hydrated 80-85%	lb.	.06¼	.06½-.06⅝
Potassium chromate (K_2CrO_4) 450 lb. bbls.	lb.		.16
Potassium hydrate (KOH) (caustic potash)	lb.	.06¼-.06½	.08-.08½
Potassium nitrate (KNO_3) (gran.)	lb.	...	.06-.06¼
Potassium permanganate ($KMnO_4$)	lb.	...	.19
Powder blue	lb.	...	.17-.18
Rare earth hydrate 100 lb. drums	lb.	...	.35
325 lb. barrels	lb.	...	.30
Rochelle salts, bbls.	lb.	...	.12½
Rouge	lb.	...	Po. or Gr. .13½ / Cry.
Rutile (TiO_2) powdered, 95%	lb.	.10-.12	.13-.15
Salt cake, glassmakers (Na_2SO_4)	ton	18.00	27.00
Selenium (Se)	lb.	...	2.40
Silver nitrate ($AgNO_3$) . (100 oz. bot.)	per oz.	...	.39
Soda ash (Na_2CO_3) dense, 58%— Bulk	Flat Per 100 lb.	1.10	...
In barrels	Per 100 lb.	1.50	...
In bags	Per 100 lb.	1.25	...
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06½	.06½
Sodium chromate ($Na_2CrO_4 10H_2O$)	lb.	...	.08
Sodium fluosilicate (Na_2SiF_6)	lb.	.04¾	.05¼
Sodium hydrate ($NaOH$) (caustic soda) Flake	Per 100 lb.	3.00	...
Solid	Per 100 lb.	2.60	...
Sodium nitrate ($NaNO_3$)— Refined (gran.) in bbls. 95% and 97%	Per 100 lb.	...	2.00-2.25
Bulk	Per 100 lb.	1.175	...
200 lb bags		1.24	1.29
100 lb. bags		1.275	1.325
Sodium selenite (Na_2SeO_3)	lb.	..	1.80-2.00
Sodium uranate (Na_2UO_4) Orange	lb.		1.50-1.55
Yellow	lb.	...	1.50-1.55
Sodium uranyl carbonate	lb.	...	.80-.90
Sulphur (S)— Flowers, in bbls.	Per 100 lb.	3.35	3.70-4.10
Flowers, in bags	Per 100 lb.	3.00	3.35-3.75
Flour, heavy, in 250 lb. bbls.	Per 100 lb.	2.90	3.25-3.65
Tin chloride ($SnCl_2$) (crystals) in bbls.	lb.	...	.38½
Tin oxide (SnO_2) in bbls.	lb.	...	.53
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	...	3.00
Yellow orange	lb.	...	1.50
Zinc oxide (ZnO) American process, Bags	lb.	.0575	.06
White Seal, 150 lb. bbls.	lb.	.10½	.10¾
Green Seal bags	lb.	.09½	.09½
Red Seal, bags	lb.	.08¾	.08¾
Zircon Granular (Milled .005-.02c higher)		.07	.67½-.08
Crude. Gran. (Milled .005-.02c higher)		.03½	.04-.0

C. P. OVERMYER, President

Expansion Built on Service

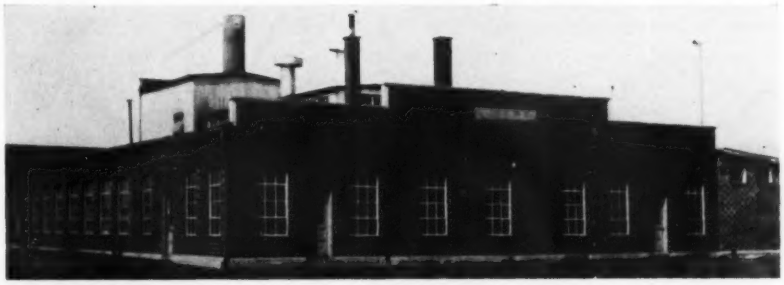
Overmyer has always felt that mere metals and machinery do not build success—creative design and craftsmanship in production are the priceless ingredients.

MOULDS DESIGNS

The recent establishment at Greensburg, Pa., of the new Overmyer Mould plant is solely the result of honest service to the glass industry.

Pressed Ware and Novelty Moulds
OVERMYER MOULD CO. OF PA.
GREENSBURG, PA.

MOULD CASTINGS

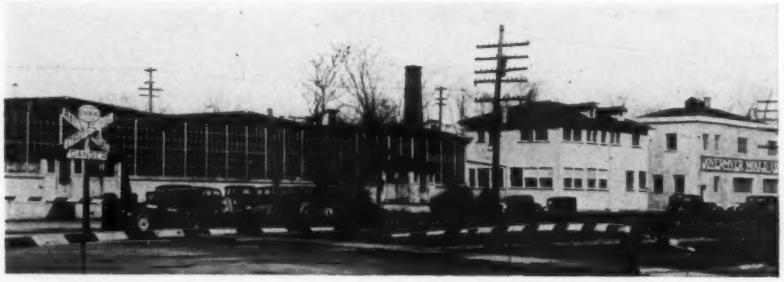


A design and consultation service is offered by the new branch in addition to facilities for producing all forms of moulds for glassware and glass specialty production.

The only foundry in the world devoting its entire service to glass factory moulds.

FOUNDRY DIVISION
OVERMYER MOULD CO.
WINCHESTER, IND.

MOULDS MODELS DESIGNS



The entire Overmyer organization is ready to serve customers of one or all three plants.

Bottle and Container Moulds.

OVERMYER

MOULD COMPANY
WINCHESTER, IND.

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It is preferred where the demands are most exacting. It is not affected by oxidizing or reducing atmospheres. There is no permanent shrinkage or expansion at 2,550 degrees F., and less than 0.5% at 3,000 degrees F. No deformation in A.S.T.M. Standard load test. P. C. E. Cone 37-38.

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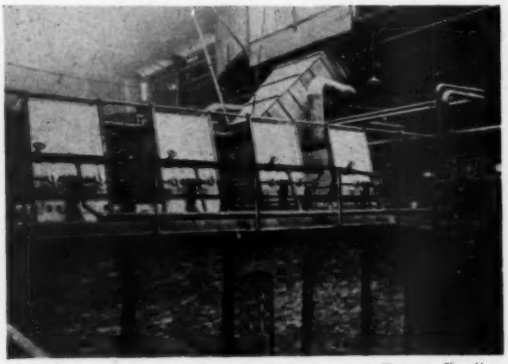

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83/85%

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K & B Wind System for cooling tank blocks on glass furnaces. Note new vertical cast aluminum nozzle—one of the K & B improvements that insures maximum efficiency.

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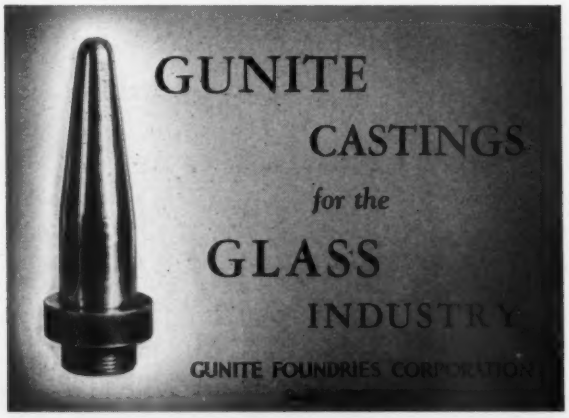

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Iron Chromate
Iron Oxides
Iron Sulphide
Lead Chromates
Lepidolite
Manganese Carbonate
Manganese Dioxide
Magnesium Carbonate
Neodymium Oxalate
Nickel Carbonate
Nickel Oxides
Nickel Sulphate
Polishing Rouges
Potassium Bichromate
Potassium Carbonate
Potassium Chromate
Powder Blue
Putty Powders
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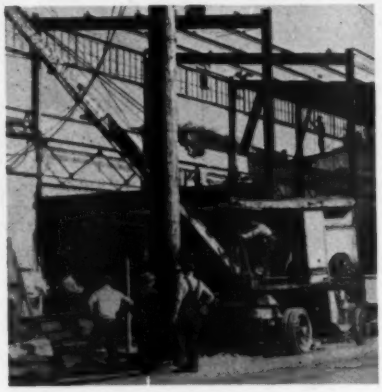

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